Pit and Quarry

SAND · GRAVEL · STONE · CEMENT · LIME · GYPSUM

Announcement

to Our Readers

BEGINNING with an issue on Wednesday, July 7th, 1926, the type page dimensions of PIT and QUARRY will be enlarged to standard size 7″ x 10″, instead of the smaller size of the past, and PIT and QUARRY will be published thereafter on every other Wednesday, instead of on the first and fifteenth of each month as heretofore. We believe every reader will welcome this change.

May 15, 1926

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Pit and Quarry

A Semi-Monthly Publication for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

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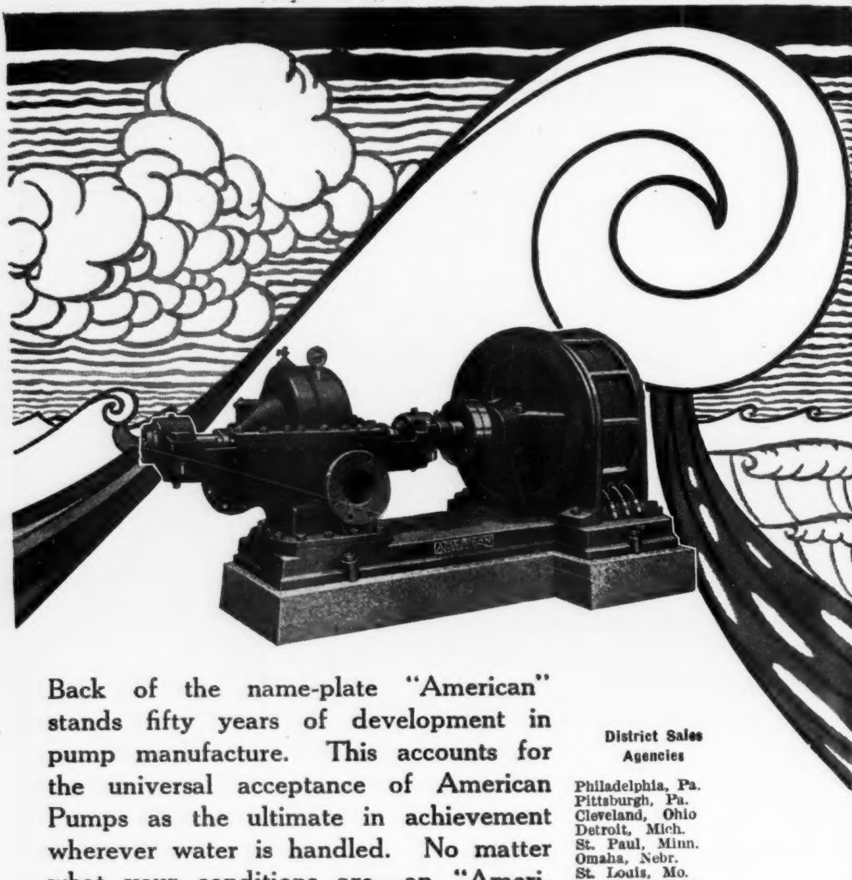
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Pit and Quarry

Vol. 12 Chicago, Ill., May 15, 1926 No. 4

New Phases of Competition

COMPETITION in its most interesting aspect is presented by O. H. Cheney, vice-president of the American Exchange-Pacific National Bank of New York, in a discussion which will appear in "Nation's Business" for June, 1926. The writer touches on many phases of business and presents the problem from various angles in his analysis of the elements of "The New Competition." "Ten years ago," Mr. Cheney says, "distribution and competition were not what they are today. In fact the methods of yesterday in many lines will probably be antiquated tomorrow. Those of us who are thinking in terms of yesterday's competition are asleep. The noises which you hear in trade association convention halls, in congressional corridors and in the courts are the moans of such business men tossing in their sleep; and the loud cries you are hearing more often are those of some business men waking up with a start to the new competition."

Old cut-throat methods of competition are rapidly becoming obsolete, and a new spirit of co-operation is taking their place. "When two men in the same line meet, they start talking about cooperative advertising or standardizing sizes, eliminating unnecessary styles, uniform cost accounting or standard terms to the trade . . . Competition breaks away from old lines, jumps across established methods, and travels up and down the very line of distribution itself." Mr. Cheney even suggests the advisability of replacing the word competition with the more exact term, "distributive pressure." So universally have we associated the idea of "fighting it out" with the former term that it no longer describes the complicated structure of modern business. "The new competition is, broadly, pressure for distributive outlets; where this pressure was formerly exerted within certain established channels, the intensity of competition has broken down and is making its own channels. The basic reasons for these terrific and newly directed pressures are, of course, the surplus plant capacity available for production and the tremendous progress in the arts and sciences of promotion and exploitation through advertising, publicity and salesmanship. These pressures are impatient; they will not allow the stream of distribution to work through from producer to consumer at the old, slow rate. And this accounts for numerous merchandising phenomena which, seen alone, seems strange and often inexplicable; but when viewed together from this angle they are seen really to be different currents and eddies in one stream. Such phenomena, for example, are hand-to-mouth buying, instalment buying, direct selling and group buying."

This distributive pressure is shown to work in many directions and to function in every line of business. It brings about an entirely new competitive system. Competitive marketing organizations, chain-store systems, mail order selling, "endless chain" schemes are some of the results of this frantic necessity to sell. The fate of the independent retailers is endangered and reveals the certainty that the old idea of competition has given place to the new. The competitor is no longer the man across the street. Competition is intra-industrial, not individual. "Not only do retailers compete with each other, wholesalers with each other and manufacturers with each other, but individuals in each group compete with those in other groups—often with those who may be distributing or manufacturing their products. This competition may be observed at the very beginning of the process, with the producer of the raw material . . . A copper mining company buys a brass factory. Growers in many agricultural lines form gigantic cooperative marketing organizations."

Another type of competition is that which exists between two divisions of the same general industry which produce commodities used alternately. This type is called inter-commodity competition. The competition among such commodities as lumber, brick, stone, cement, tile and new combinations presents a bewildering problem to the man who contemplates building a home. The competition of oil and coal, of the truck and railroad transportation, of bus and street car tends to render more complex the status of business activities. "That this type of competition is increasingly recognized," says Mr. Cheney, "is proved by the growth of trade associations and of their constructive cooperative activities on behalf of all interested in a particular commodity or service, and sometimes of destructive efforts against competing interests."

Of all phases of competition inter-industrial competition is of most recent development and of greatest economic significance. It is futile to ignore it and essential to accept it. "It is the competition of all industries for as much as they can get of the national income—for their share and more of the consumer's dollar . . .Inter-industrial competition is one aspect of the pressure of goods for outlets—of increased pressure due to over-capacity for production. This pressure, working through all the powerful machinery of advertising exploitation, has raised the American standard of living to the highest in the world and in history. The ways of spending money have been multiplied a thousand-fold. And, in turn, the American standard of living, especially the margin over subsistence, stimulates more production and new products. Work makes work and buying power makes buying power. There is the circle—not vicious, but certainly vital." Instalment selling has increased with amazing rapidity during recent years. The automobile industry has led in this method of financing sales. Other industries are certain to follow. Almost all luxuries may now be secured on time; necessities may follow this plan also if dealers feel that instalment selling gives them a greater hold on the purchasing power of the people.

These are some of the most significant phases of present day competition, but "overshadowing all these types of competition in the vastness of its effects is international economic competition. True, it is old, but its effects are ever with us—more violent than ever in the last decade. Every day brings new evidence that the distributive pressure of nations is becoming more intense. The techniques of exploitation which have been developed in internal competition have been held in abeyance because of economic difficulties in other countries. When they become active, it is difficult to prophesy what the next few years will bring."

These new phases of competition indicate a marked change in the mental attitude of business. The belief that so long as a business man's conduct came within the strict technical rules of law he was immune from public or private attack has practically disappeared. Today a corporation not only sees that it violates no law but that it acts in accord with public opinion and a reasonable code of ethics. Customers, employees, competitors and the public must all be considered today.

Public opinion is an important factor in the new conception of competition. Its power cannot be fully estimated but it is respected by the management of every worthwhile business. A business institution today dreads the condemnation of even a few individuals although it might be unfair. This condemnation becomes many times more powerful as it is multiplied by added opinions. This factor of public opinion is powerful enough to stifle an industry.

Practically all the business in the non-metallic mineral industries is carried on by negotiation. Transactions generally occur among men through personal contact. Misrepresentation and overstatement of facts will certainly result in discredit for the business institution involved. Frequent instances of such practice will react with a tremendous force unfavorably toward the entire industry involved. The old methods of competition are rapidly becoming obsolete and it behooves every institution in the non-metallic mineral industries to take a mental inventory and determine if the new spirit of cooperation is reflected in their organization.

Making Lime in Hoosatonic Valley

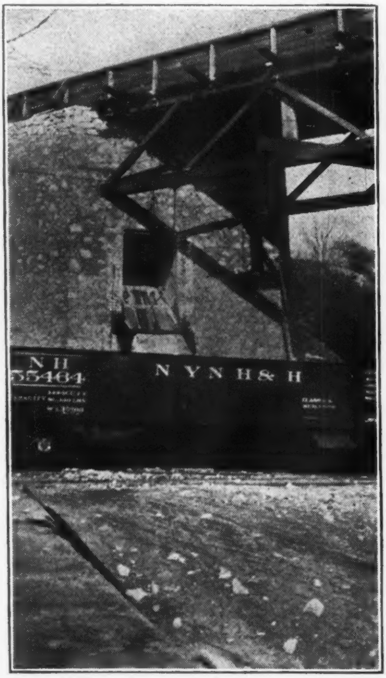
By F. A. Westbrook

APPROACHING the New England Lime Company's plant in the Hoosatonic Valley near New Milford, Connecticut, the first impression one receives is of neatness and careful layout. There is a well kept woven wire fence around the grounds, a small attractive, office building near the entrance and a conspicuous absence of litter about the premises. It is always a pleasure to visit a plant kept up in this way because it almost invariably means that it is a good plant with interesting things to observe.

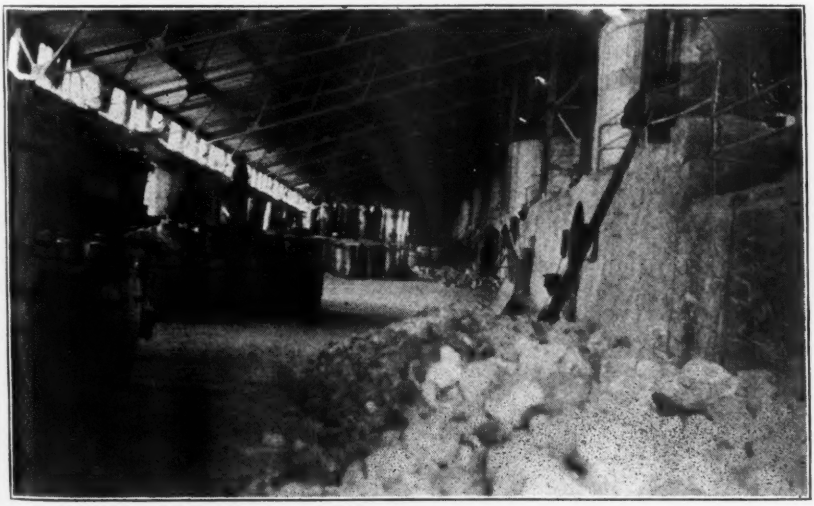
This operation is no exception to the rule. It is about thirty years old and consists of nine kilns and two quarries, together with other necessary appurtenances.

One of these quarries has the unusual feature of being reached through a tunnel over six hundred feet long from an old abandoned working. The entrance is shown in one of the illustrations. There is sufficient head room so that a man can walk through it in an upright position and it is wide enough for men to walk on either side of the tracks. It is also electrically lighted.

The main track leading into the quarry branches off to several points



Chute for Loading Stone Into Cars.



Lime Drawing Floor; Note Steel Barrels in Background.

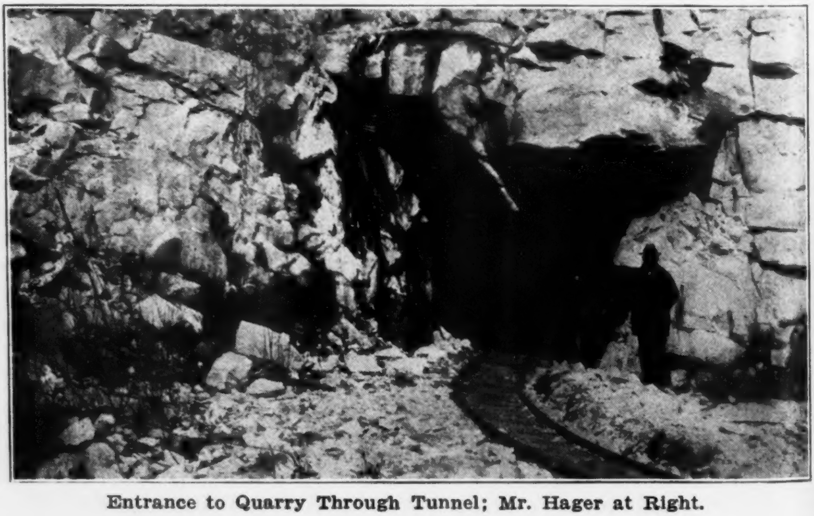
View of Quarry Breast Showing Drill Works.

at the breast for workmen to load cars, as is usual in lime-stone quarries. One of the illustrations shows the men loading the cars, which are of the Koppel side dump type.

Drilling for the main blasting is done by means of Ingersoll-Rand compressed air hollow steel butterfly drills. The holes are drilled about six feet and a half back from the face, six and a half feet apart and about twenty feet deep. Each of these is charged with about three boxes of Atlas 40 per cent gelatine dynamite, the sticks being one and a quarter inches in diameter. As the working breast is about one hundred feet across, fifteen holes are drilled at a time.

The usual Ingersoll-Rand jack hammers are used for drilling "pop holes" and one inch diameter sticks of dynamite for breaking up the large pieces. About one hundred and twenty-five tons of stone are moved a day. Two Plymouth gasoline locomotives are in service to haul the cars, one number 4 and one number 5, from the quarry entered through the tunnel.

The storage space for extra stone is along the tracks leading from this quarry. It is necessary to accumu-



Entrance to Quarry Through Tunnel; Mr. Hager at Right.

Loading Dump Car in Quarry.

late a surplus supply of stone during the winter because a good deal of time is lost in the spring due to the necessity of clearing up the accumulation of dirt and powdery material which freezes and is impossible to remove until the mild weather sets in. Stripping, of course, is also impractical in winter.

Some of the limestone is sold for flux in steel mills and this is taken in the cars and dumped into a chute which discharges into a freight car, as shown in one of the pictures. The sides of this chute are made of concrete and the inclined bottom of a series of railroad rails laid close together, bottom side up, in cement. This is a very practical arrangement, capable of withstanding the very hard usage to which it is subjected, and is the idea of L. A. Hager, the superintendent, who has been with this company for twenty-six years. Of course, there is a good deal of track between the quarries and the kilns and this was purchased from Foster and Company of Pittsburgh. The stone from the quarry entered through the tunnel is hauled by the Plymouth

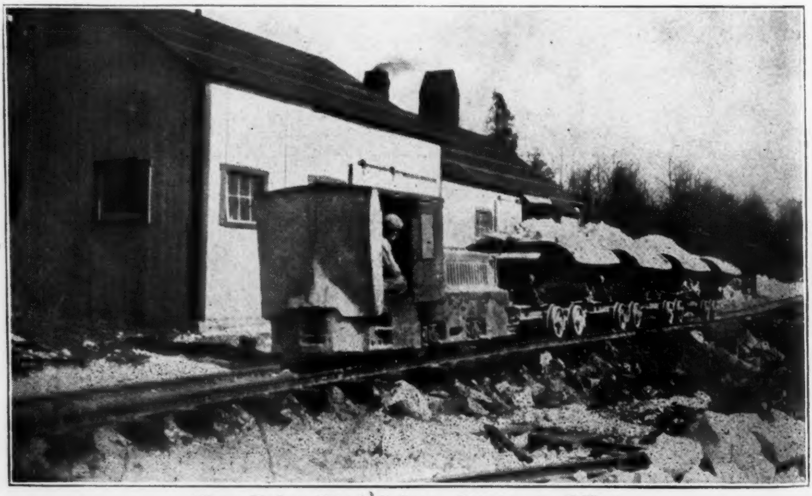
Kilns Showing Pile at Right; Car Trestle Above.

End Dump Cart for Hauling Hot Lime.

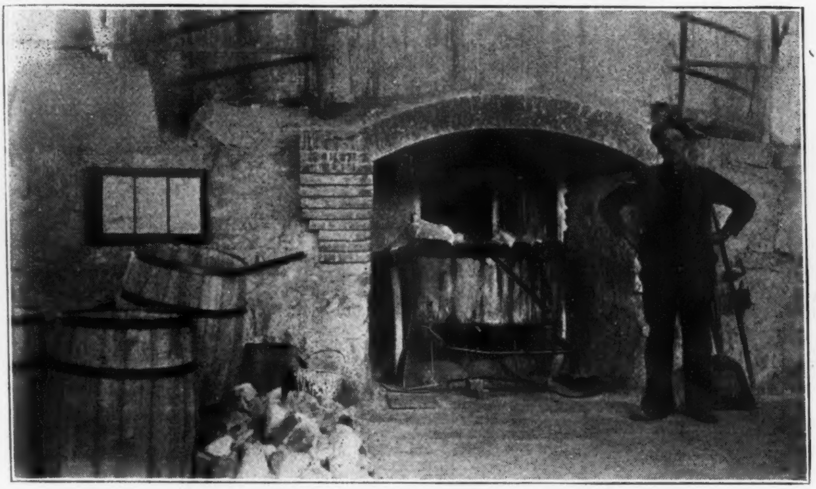
locomotives directly on to the trestle over the tops of the kilns. The stone from the older quarry, the bottom of which is far below the kilns, is hauled up to the tops of the kilns over a one hundred and seventy-five foot incline, with a grade of seven inches to the foot, by means of an American Hoist and Derrick Company's hoist. The cable for this is seven hundred and twenty-five feet long and is an American Steel and Wire Company's Roebling yellow strand cable. The hoist is operated by a thirty-five horse power General Electric Company two hundred and twenty volt induction motor.

Compressed air for the drills is furnished by an Ingersoll-Rand 10 x 12 compressor, driven by a fifty horse power General Electric motor, and a 10 x 12 Sullivan compressor driven by a fifty horse power Westinghouse motor. In a room adjoining the compressors is the boiler for supplying the kilns with steam. This is a sixty horse power boiler made by the Biglow Company of New Haven, Connecticut.

There are two groups of kilns—one of seven and one of two. Both are charged from the trestles and coal is the fuel used. Their appearance is shown in the picture. The fireing floor is some ten feet above the lime



Cars Being Hauled from Quarry to Kilns.

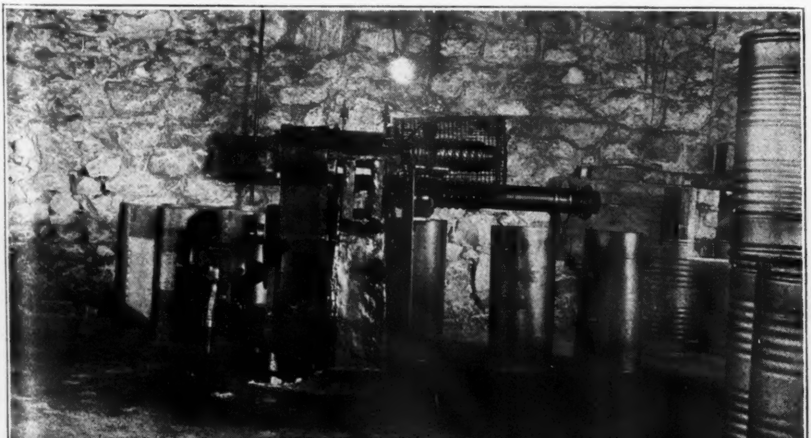


Drawing Lime from Kiln to End Dump Cart.

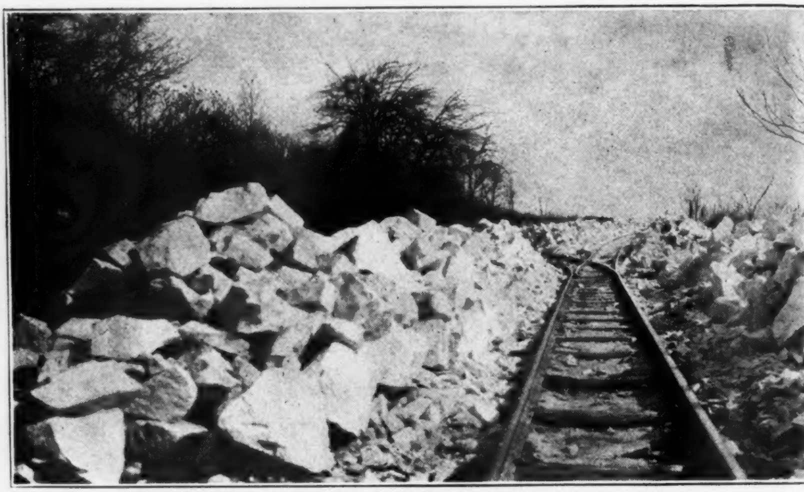
drawing floors and the coal is discharged from freight cars on a siding at this upper level.

When the burned lime is drawn from the kilns it is pulled into steel dump carts by means of long iron hooks. Both the carts, one of which is shown in detail in an accompanying illustration, and the hooks are made at this plant. The carts are even sold to other lime producers when the occasion arises, but this kind of business is not particularly sought. After the hot lime has been placed in these carts, it is taken to a convenient spot on the floor and dumped for cooling. The tail board of the cart swings outward when released by a lever in front so that by tipping it the material drops to the floor. A good many steel wheel barrows are used and these are made by the Toledo Company.

A great deal of the lime is shipped in steel barrels with wood ends. These barrels are made in a shop at the end of the kiln house. In fact, enough barrels are made here to supply the needs of all four of the New England Lime Company's plants. The machinery for making these was made by the D. H. Stoll Company formerly of Buffalo, but which is now owned by a company in Southington, Con-



Machine for Rolling and Corrugating Sheet Steel for Barrels.



Tracks from Quarry to Kilns Showing Storage Pile.

necticut. This machinery has been so well developed that four men can make six hundred barrels a day. It is electrically driven. General Electric motors are used. Some of the lime is also shipped in wood barrels. Each kiln has its own Fairbanks scales for weighing barrels, etc., and all the platform scales in the plant are also Fairbanks.

One of the striking features of this plant is the excellence and permanent character of the buildings. The roofs are supported by steel work and the side walls are either entirely of corrugated galvanized iron or partly that and partly masonry. Some of the illustrations give a good idea of the construction. The dump piles and the grounds in general are kept in an unusually neat condition by Mr. Hager.

There are railroad sidings on each side of the kiln houses. On one side the coal is dumped off and on the other, at a lower level, the finished product is loaded into box cars.

"Make It Safe" is the title of a new booklet just issued by the National Safety Council. It contains more than fifty pages of information which should interest workers in industrial establishments.

Machine for Preparing Sheet Steel for Barrels.

A Comparison of Fuel Burning Methods

By Charles Longenecker

Coal—Handfiring

THE simplest and oldest method of burning solid fuels has been designated "hand-firing." In the early days when the wants of men were few and the term "cost of output" unknown the hand-fired system met all requirements. Today this method is still found adequate in many cases although when considered from an efficiency standpoint it is the most wasteful manner of burning fuel. Where labor and fuel are low priced and the weight of fuel burned is comparatively small there exists no necessity of employing a costlier method as the saving in fuel will not justify an expenditure for equipment. Paradoxical as it may seem there are some cases where it pays to waste.

The large losses come from the loss of combustible in the ash and the loss of heat due to excess air. Intelligent manipulation of the fuel bed will very materially reduce such losses. Handfiring may be practiced with either natural or forced draft. Probably the easiest way to visualize the inherent weakness of hand-firing is to investigate the conditions that obtain.

One serious fault is the non-uniformity of the coal in size. Very rarely is the coal crushed. This means that the fuel bed will not have a uniform resistance to the air passing through it. Some portions of the bed will offer greater resistance than other portions. The greater quantity of air will flow through the least obstructed channels and that portion not coming in contact with the carbon of the coal will simply extract heat. If the fuel bed could have a uniform resistance throughout there would be a decrease in loss by excess air.

The bed over the grate bars is made of coal in various states of decomposition by lying on a layer of ash. The ash naturally introduces another factor. If it forms in large clinkers the air cannot penetrate. This is the condition when the ash has a low fusing point, which very frequently is indexed by high sulphur in the coal. If the ash forms in comparatively small pieces the air can more easily penetrate. Here again intelligent firing is reflected in hgher CO_2 in the furnace gases.

The depth of the fuel bed is very important. If too great there will be a "gas producer" effect and coal wasted due to the escape of unconsumed carbon. This is rarely the case for any lengthy period. More frequently at one period there is excess air and at another, when coal is freshly charged, there is a deficiency of air.

The loss of combustible is partly due to the fine coal sifting through the grate bars. This is hard to prevent. If the bars are too close they will obstruct the flow of air. If too far apart the coal will fall through the open spaces between the bars. Combustible also is lost when unburned coal, or coke, drops through the grate. This loss is very high but can be reduced by careful attention and skillful manipulation of the fires. The per cent of combustible in the ash, in furnaces equipped with stokers, runs as high as 35 per cent and in hand-fired furnaces it is very frequently much higher.

This can be appreciated by citing an actual case. An ash contained 45 per cent combustible and the coal had an ash content of 12 per cent. For every 100 pounds of coal burned 22 pounds went into the ash pit and of this ash 10 pounds represented combustible. The weight of combustible matter—carbon and hydrogen—in each 100 pounds of coal was 84 pounds. Thus the loss in heat value was 10 divided by 84 or 12 per cent. This represents the waste of heating power above. Freight was paid on this discarded fuel and an additional amount expended to haul it to the ash dump.

With all its inherent weaknesses it is problematical, in many localities, whether any other method of firing would return a saving. As is always the case, an appeal to figures assists in visualizing the matter. Assume a kiln producing 12 tons of lime with a fuel ratio of 1 of coal to 2.50 of lime. One thousand pounds of lime is the output per hour and to burn this 400 pounds of coal is required. Each fire box will burn 200 pounds. In a fire box say 4 feet 10 inches deep and 3 feet wide, fourteen pounds of coal is consumed per square foot of grate surface per hour. A stoker is not warranted for this small quantity of coal as it can be easily placed by hand. Two hundred pounds represents 8 to 10 shovels of coal.

Any piece of equipment integral with the kiln must have a very low first cost to deserve consideration. The other alternative is the employment of a central system with distribution to several kilns. Oil, producer gas or powdered coal would be available in this connection. These will be considered in order.

Oil

This is an ideal fuel considered entirely from the viewpoint of its ease of handling, regulation and ease of adaptation. It has the one great drawback in that the cost fluctuates within wide limits and supply is not always assured. In certain localities it has no competitor. In cold weather there is the disadvantage of keeping the oil heated so it will flow readily. Power is necessary to pump the oil and furnish steam, or air, for atomization, while the air for combustion must be induced or furnished by a small fan. Conditions in the furnace can be maintained uniform with oil and this is a feature of importance.

Producer Gas

A modern automatic mechanical pressure producer will gasify 3000 pounds of coal per hour. One pound of coal so gasified will make 60 cubic feet of gas with a content per cubic foot of 140 B.T.U's. Assuming 400 pounds of coal, hand-fired, as necessary to furnish the heat to produce one ton of lime and assuming a coal of 13,000 B. T. U.s per pound, 4,200,000 B.T.U.s will be furnished. To equal this quantity of heat 30,000 cubic feet of gas much be supplied. As one pound of coal will give 60 feet of gas, 500 pounds of coal will be sufficient for one kiln on a production of 12 tons of lime in 24 hours. This calculation is based on delivering the gas to the kiln cold but if delivered hot a less quantity of coal would be required. The difference, corresponding to the sensible heat in the producer gas, can easily be calculated. The heat content in the gases from one pound of coal is 60 x .0198 x 1200 degrees = 1440 degrees B.T.U. .0198 is the specific heat per cubic foot of gas and 1200 degrees is the temperature of the gas.

The sensible heat in the gas from 500 pounds of coal is 500 x 1440 degrees = 720,000 B. T. U.'s. This quantity divided by 13,000, the B. T. U. content of one pound of coal, gives 55.3 pounds of coal as represented by the sensible heat in the hot gas.

If the requirement for one kiln is 500 pounds of coal, one gas producer gasifying 3000 pounds of coal per hour will have capacity sufficient for six kilns.

Approximately one thousand pounds of steam per ton of coal charged will be blown into the producer. To furnish this there must be a boiler which may or may not be a part of the plant equipment. One man can tend the producer and fire the boiler. The piping from the producer to the kilns is quite an item of expenditure. It should be brick lined.

Such an installation as that just outlined has advantages from an operating standpoint but the first cost would be so high that it could only be considered under the most favored conditions. Another factor which must be considered is the advisability of placing dependence for the continuous operation of six kilns on one producer. Any failure of the producer would mean the interruption of all kilns. This feature naturally applies to any system which involves a central source of fuel supply. Where it is desired to burn lime with producer gas it is feasible to build a producer integral with the kiln. This was the practice in by-gone days and in other lines of industry it is being followed today. The cost of such an installation is not excessive. The disadvantage is the cost for labor and for coal conveyance.

Powdered Coal

In a previous issue of Pit and Quarry the writer ventured the suggestion that powdered coal be considered as a fuel for vertical lime kilns. It is appreciated this suggestion is of a radical nature and its success can only be determined after a thorough trial.

The burning of lime is an industry differing in many respects with any other. It is still carried on in a primitive manner and any attempt to place the operating methods on a more advanced plane meets with the insurmountable obstacle of increasing costs which the industry cannot bear. The only alternative in such a case is to improve the methods now employed. Laying aside then any intention of installing new equipment, attention may be directed to suggestions for bettering operating conditions as found at present. Two factors can be changed—the coal and the human factor. If the coal is not of the correct quality there is no recourse but to make a change. If the coal is satisfactory it is possible to reconstruct the personnel and secure higher efficiencies.

In America we have so many varieties of coal it is possible to meet most any analysis unless cost of transportation is prohibitive. Analysis is not always a positive determination for the success of a coal as other factors may exert an influence not apparent in analysis. Beside the "proximate" and "ultimate" analysis of a coal the purchaser should know its B. T. U. content and the fusing point of the ash. An analysis of the ash also assists in indicating the tendency to clinker. This is illustrated in an analysis of the ash from four coals which was:

Composition	Non Clinkering	Fair	Clinkering	Bad
SiO_2	54.67	46.23	46.40	43.50
Al_2O_3	41.95	31.93	16.45	17.10
Fe_2O_3	Trace	14.54	18.5	28.10
Ca O	1.82	5.04	11.80	5.30
MgO	1.42	2.26	4.63	0.75
S	.55	1.50	3.00	2.70

A glance at these figures reveals the influence of iron, as expressed by Fe_2O_3, on the clinkering qualities. Sulphur also is an index and it will be generally found that high sulphur coals have a low fusion point ash and hence clinker at a low furnace temperature. Sulphur in coal is found mostly as pyrites, or FeS_2, which as the symbol is a combination of iron and sulphur.

Many industrial plants select several coals which appear to be of the grade desired and then run a series of tests to determine which coal will in practice give the most satisfactory results. There is no better method to arrive at a solution of the coal problem than to subject the fuel to an actual test. Some time ago a plant in the Middle West adopted this plan with very satisfactory results. Power plants follow the same practice. Each plant has its own peculiarities of operation and while a coal in one plant may prove a big success, in another it may be totally unfit.

The same applies to the method of firing. By experimenting the fireman may find he can improve his furnace condition. The quantity of air passed through the fire should be varied and the depth of the coal bed changed. To assist in such experimenting, draft guages, CO_2 recorders and pyrometers will be of value.

Ashelford and Sons

W. H. Ashelford and Sons have constructed a washing and screening plant just north of Byron, Ogle county, Illinois. The foundation is 18 x 60 feet long with three walls the full length of foundation 3 feet wide at the base slightly tapered at the top. It is 11 feet high, with a concrete floor 18 inches thick, well reinforced with heavy steel. Upon this floor are 5 bins for sized material. Under each bin is a discharge gate for truck loading. The capacity of the bins is about 20 cars.

The gravel is excavated by a slack line cableway with a 1½ yard bucket over a six hundred foot span. The mast is 90 feet high. The material is raised to a height of 70 feet and dropped into a hopper covered with a grizzly screen, which takes out all of the oversize. The oversize is run through a jaw crusher and goes from the crusher to the stone screen. The firm is marketing three grades of stone and two of sand. The water for washing is pumped from a well 4 feet in diameter which is supplied from the Rock River. The gravel does not need washing for dirt or foreign matter as it is free from all impurities. The pit has a depth of from 75 to 100 feet. The firm has 40 acres of good hard stone land, suitable for concrete use.

Westinghouse Names Duncan Assistant Sales Manager

J. McA. Duncan, for fourteen years Pittsburgh district manager, has been promoted to assistant general sales manager of the Westinghouse Electric and Manufacturing Company. W. R. Marshall, formerly branch manager of Buffalo has been selected to assume the duties of Pittsburgh district manager. These appointments are effective May first.

Mr. Duncan, who has been in the employ of the company for forty years, has worked in almost every department. This wide experience, coupled with unusual executive ability eventually led to his recent appointment.

In addition to these appointments, H. F. Boe, formerly industrial division manager at Buffalo, has been promoted to branch manager, of that office, and R. L. Kimber to industrial division manager. W. F. Barnes is appointed branch manager of the Tulsa office.

Tentative Lime Convention Program

June 8, 9, 10 and 11, 1926
French Lick Springs Hotel, French Lick, Indiana

Tuesday, June 8

Morning 10:00 A. M. Directors' Meeting (First Session)

Afternoon 12:30 P. M. Lunch
1:30 P. M. Executive Meeting of Full Membership
Appointment of Committees
Audit
Resolutions
Maxet Committee Report
Central Division, — W. H. Magee, Mgr.
8:30 P. M. Round-Table (Manufacture)

Wednesday, June 9

Morning 10:00 A. M. The Market for Lime—
Irving G. Fellner, Business Mgr.
McGraw Hill Publishing Company, New York City
10:45 A. M. Economical & Substantial Construction
J. P. Mollenkof, Supt. of Constr.
John H. McClatchy Co., Philadelphia, Pa.
11:30 A. M. Balanced Publicity
R. P. Brown, Mgr.
Publicity Dept., N. L. A.
(Discussed by J. M. Deely)

Afternoon 12:30 P. M. Lunch.
1:30 P. M. Concrete, Asphalt and Dirt Roads
C. R. Stokes, Mgr.
Highway Dept., N. L. A.
(H. W. Wood to discuss dirt roads)
2:30 P. M. Opportunities Industrial Field
L. B. Burt, Mgr.
Industrial Dept., N. L. A.
(Discussed by H. E. Fitzroy)
4:00 P. M. Ladies Afternoon Tea
(By Courtesy of French Lick Springs Hotel)
7:00 P. M. Banquet — Compliments of the French Lick Springs Hotel, Entertainment furnished through the courtesy of the Valve Bag Company of America.

Thursday, June 10

Morning 10:00 A. M. Executive Session
"What is Wrong With the Lime Industry"
W. E. Carson, President Riverton Lime Company
Full discussion by membership
Adjoined Business Meeting of Full Membership
Reports of Committees

Afternoon 12:30 P. M. Lunch
1:30 P. M. There Is No Substitute
J. S. Elwell, Mgr.
Construction Dept., N. L. A.
(Discussed by C. M. Cadman)
2:15 P. M. The Practical Aspects of Research
G. J. Fink, Director
Association Laboratories, N. L. A.
(Discussed by G. T. Weigart)
3:00 P. M. Directors' Meeting
8:30 P. M. Round-Table (Manufacture - Second Session)

Waukesha Motors Expanding

Waukesha Motor Company, Waukesha, Wisconsin, due to the diversity of their business, building automotive bus and truck engines and heavy duty industrial power units, are running at full capacity day and night to keep up with orders. The company is accepting new orders only for delayed deliveries, but this condition they expect to correct in the next sixty days at which time they will be occupying a new 24,000 square foot building. With this new addition and the extra machine tool equipment which it contains they will be able to take care of their rapidly increasing business.

Kyrock

By H. St. G. T. Carmichael

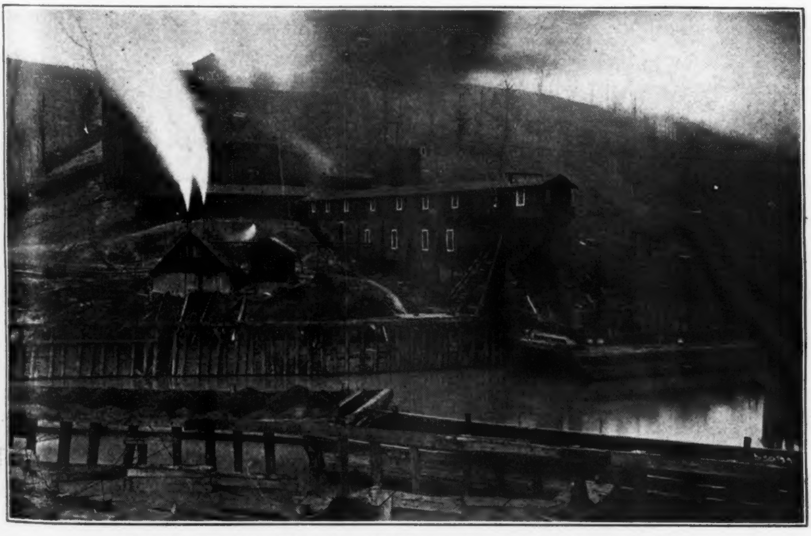
General Superintendent, Kentucky Rock Asphalt Company

FOR countless centuries, in the remote regions of Edmonson County, Mother Nature has held concealed in her bosom and manufactured by her own slow but thorough process, a product which is fast becoming recognized by engineers in the United States and adjacent Countries as being a most perfect road surfacing material known today, namely, Kyrock as produced by the Kentucky Rock Asphalt Company at Kyrock, Kentucky.

Rock Asphalt in itself, is no new discovery and is very well known in Highway construction, having for a century or more been successfully used by European engineers in France, Italy, etc. and recognized by them as being the highest type of pavement but it was not used in the United States to any great extent until about 30 years ago. However, today Kyrock is being produced at the rate of over 4,000,000 square yards annually and being used for paving and many other purposes throughout over thirty states and several foreign countries.

Fifty years ago, realizing the value of Rock Asphalt as a paving material and being unable to discover deposits of it at home, our engineers imported some of it from Europe and in 1872 laid the Compressed Neuchatel type in Union Square, New York. Later on, the European product was also used in several other cities along the Atlantic Coast, including a stretch in St. Augustine, Florida, put down in 1886. Finding cost of such construction almost prohibitive due to the enormous expense of transportation, our engineers, ever on the alert and not to be outdone by the Old Country, very ingeniously invented a substitute for Rock Asphalt in the form of a hot mixed artificial type of pavement composed of asphalt and sand. This type has proven a passable substitute but is not considered as satisfactory, desirable and economical as Nature's own ready mixed product which needs only to be quarried, pulverized and laid down cold.

For a hundred years or more, natives of Edmonson County, Kentucky have known of the presence of Rock Asphalt but being far removed from the outside world and having no need for roads other than trails leading from the cabin of one pioneer to another, they gave it no heed but did use it for calking their skiffs and barges, the ooze of heavy asphalt bitu-



Kyrock Harbor Showing Delivery End of Belt Conveyor.

of Green and Nolin Rivers and throughout the major portion of the county north and east thereof.

Due to their inaccessibility, these valuable deposits, destined to revolutionize American road building, remained hidden to engineers until about 30 years ago, after the Federal government had established locks and dams on Green River and its tributaries. Then came some enterprising Pennsylvanians, who recognized the merits and possibilities of this wonderful material and immediately started to produce on a modest scale, a paving material which was at once tested out and accepted by engineers in several states and was laid successfully in New York, Pennsylvania, Kentucky, Tennessee and other states with the result that today, thousands of square yards of this early production are in excellent condition and stand as a silent monument to the real merits and worth of Kyrock.

From this modest beginning has in a few years sprung the present company which alone produces Kyrock and can point with justifiable pride to the fact that its product is accepted by the leading engineers and highway officials throughout the United States, and has proved its worth under the most exacting conditions of climate and traffic. Prominent installations of Kyrock which have been subjected to unusual wear over a period of years are stretches of the Lincoln, Dixie, Jackson and other National highways, also on Sacramento Avenue and other busy boulevards of Chicago; the Biscayne Bay Causeway at Miami, Florida; the pike between Cincinnati and the Latonia Race Track; the highway leading to the artillery training grounds at Camp Knox, which withstood the brunt of heavy steel-tired war time traffic and at hundreds of other points in Indiana, Illinois, Ohio, Pennsylvania, New Jersey, Virginia, North Carolina, Georgia, Alabama, Missouri and other states, where traffic and climate combine to produce trying conditions for a road surfacing materail.

Kyrock makes a smooth and permanent pavement when laid on proper base. It is laid cold and has all of the good points and is singularly free from the undesirable features common to the artificial hot mix. It is composed solely of the best known grade of clean, sharp, perfectly graded silica sand, thoroughly coated throughout and bound together into a solid rock formation by a pure natural asphalt or bitumen.

Absolute precision is practiced in maintaining the perfect uniformity of Kyrock. Before opening up a quarry, the entire acreage is laid out in 50 foot squares and tested exhaustively with diamond drills and

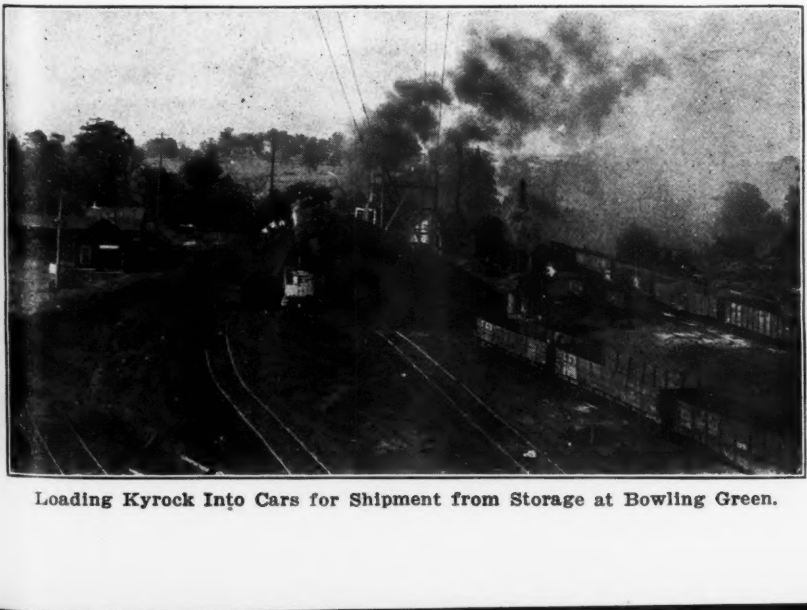
View at the Plant Showing Hand Selection of Rock in the Pit for Transportation to the Crusher.

men which, where exposed to the rays of the sun, "bled" from the rich deposits of Rock Asphalt outcropping almost continuously along the highlands the daily production is under constant laboratory control with the result that there is seldom found a variation of more than 2 or 3 tenths of one per cent in the bitumen content of Kyrock. The superiority of Kyrock as a wearing surface under traffic is due to this precise quality of its uniformity plus the constant factor in the quality of the bitumen and aggregate. The asphalt in Kyrock has been seasoned through ages, and is entirely free from foreign matter. Nature, toiling unhurriedly through unnumbered years, has arrived at perfection in this, and left no error. The aggregate is 93 per cent silica, of a sharp, angular quartz formation and the grading is perfect for an asphalt mix. Each and every grain of the aggregate is thoroughly coated with the bitumen; thus under the pressure of roller and heavy traffic the mass again assumes that perfect bond approaching its original rock form.

Kyrock, due to this uniformity of quality and content, will not bleed, shore, roll or crack under the most extreme conditions of climate or traffic. It does not buckle into that washboard appearance so common to some types which subject the base to destructive intermittent shocks. Kyrock on an adequate base stays "put" on any grade—in any climate. Nor does it deteriorate or lose its life when exposed to the elements neither when loose in the storage pile nor when compacted on the roadway. It is self-healing. Cuts in the surface will iron out and heal under traffic and leave no scar. Test sections cut from a 35 year old pavement test precisely the same as the Kyrock being shipped today. Kyrock is not heated at any stage of its production or pavement construction. Nothing is added to it, nothing is taken away. As Nature made it—so it is laid.

After deposit has been stripped of its overburden of unimpregnated sandstone, the rock asphalt is drilled, shot and quarried in the usual manner by means of steam shovels, derricks and cranes and is hauled to a 60x48 inch Allis-Chalmers primary crusher, from which it is conveyed by a 30-inch belt a distance of 600 feet to the mill where, after passing through three more crushing processes, the finished, thoroughly pulverized product is loaded on barges in Nolin River, 250 feet below the quarries. It is then towed down Nolin and Green Rivers to Rockport, Kentucky, a distance of 95 miles for shipments on Illinois Central lines or up Barren River from Green River, a total distance of 71 miles to Bowling Green on Louisville and Nashville railroad, where storage room for 100,000 tons is available.

In producing over 4,000,000 square yards annually,—and it might be well to add that demands are increasing each year,—an average force of 400 men is employed and today 10 Marion and Erie steam shovels, 12 derricks and cranes, sixteen Porter, Baldwin



Loading Kyrock Into Cars for Shipment from Storage at Bowling Green.

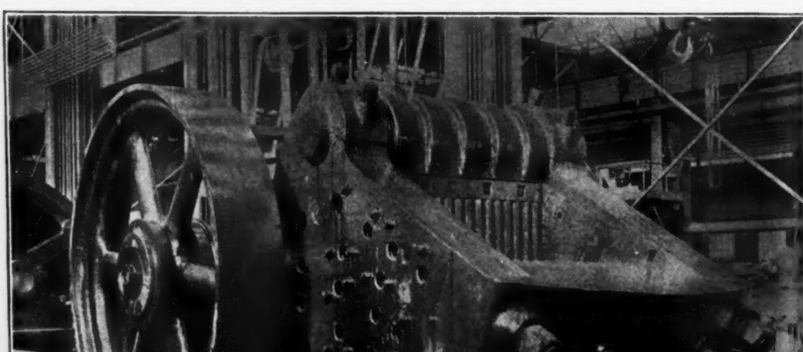
An Excellent Example of a Kyrock Highway.

An Industrial Floor of Kyrock.

and Vulcan locomotives, 125 four and eight yard Western and Continental cars, twenty odd Ingersoll-Rand, Sullivan, Keystone, Cyclone, Clipper and Armstrong drills, two compressors, Allis-Chalmers grinding machinery and other equipment totalling an outlay of over a million dollars, is being used.

The company owns over 40,000 acres of asphalt bearing property. There are several other deposits of similar appearance in the state of Kentucky, but the characteristics of the material are sharply differentiated both as to the physical character of the aggregate and the chemical composition of the asphalt.

These differences are believed by many to be due in part to difference in the bases from which the material is derived, but the greatest noticeable diversity is believed to be due to differences in age, nature's work being



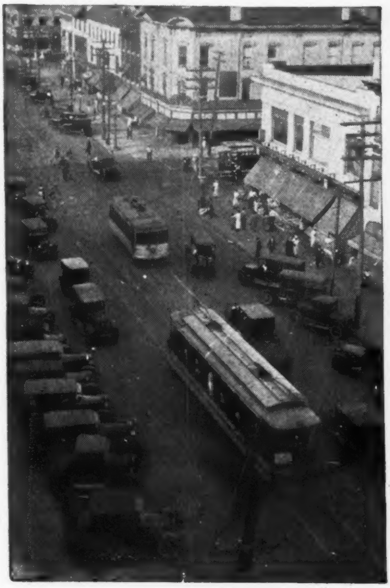
60x40 Primary Jaw Crusher.

found in various stages of progress. These differences constitute a record of the slow but unceasing changes which time effects in these, as in other organic compounds. Experiments with material taken from some of these deposits would seem to indicate that the hydrocarbon which coats the sands in them is too oily to effectively serve the same purpose which the seasoned bitumen of Kyrock serves.

The town of Kyrock, Kentucky, clustered about the mills in Edmonson County, although 20 miles from a railroad, now has a population of 1,200 souls and more than 200 buildings, including its own church, schools, stores, refrigerating plant, theater, hotel, etc. An excellent water system furnishes chlorinated spring water to all employees and the more important buildings are lighted by electricity and heated by steam.

The use of Kyrock is by no means confined to pavements and it is today being extensively used by the leading railroads on road crossing, shop floors, platforms, etc. As a surface for bridge floors it has no equal, as it reduces vibration to a minimum. Seismograph tests show that a Kyrock surface over concrete roadway reduced vibration 75 per cent.

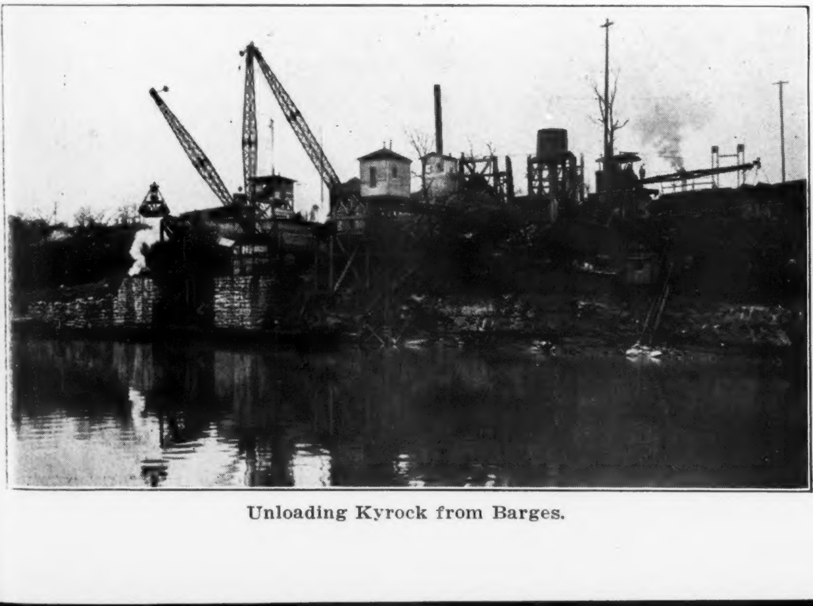
One of the many unique uses for Kyrock has been found in skin patching of worn areas and thinly resurfacing of old brick streets. Kyrock bonds perfectly to the old brick, skin patches can be feathered out at the edges and will not ravel under traffic,



Kyrock in the Business Section.

or the entire street can be converted into a smooth, resilient pavement with a thin Kyrock surface at small cost. Thousands of worn out macadam, granite block, concrete pavements, which have become cracked and rough have been economically transformed into resilient highways with a Kyrock surface.

Reports of highway engineers from various parts of the country where



Unloading Kyrock from Barges.

Kyrock surfacing has been under observation for a number of years show the maintenance cost on Kyrock pavements to be considerably less than other high type. Many installations show no maintenance cost whatever over periods of five to ten years, although under constant heavy traffic.

One of its chief advantages lies in the fact that it can be shipped in open cars, does not deteriorate in weather, is easily unloaded in hot or cold weather, with shovels or clam shells and to lay it requires only unskilled labor, a few shovels and rakes and a roller.

Kyrock has demonstrated its superiority as a wearing surface and owing to its resiliency it probably delivers its maximum degree of service over a crushed stone foundation. The cone of dispersion of load and impact is more nearly correct in the crushed stone base than in any type or design of rigid base, and the combination of crushed stone and resilient Kyrock affords o smooth absorption and distribution of the terriffic vibration and wheel shocks of motor traffic, without perceptible disturbance of the base or impairment of the surface.

The standard specifications for construction of crushed stone base for Kyrock surface call for two courses of water-bound macadam, a bottom course about five (5) inches thick of stone 3½ to 4 inch size, thoroughly rolled and bound with screenings — and a top course of crushed stone 3 inch size and about 4 inches thick, bound with screenings. The top course is thoroughly swept with fibre brooms, hand or power, to remove all dust and excess screenings until the stones protrude about ¼ inch. Upon this the Kyrock is laid, without delay, or any elaborate preparation. This type of roadway, eighteen feet wide, will require 4500 tons of crushed rock per mile and 700 tons of Kyrock.

In resurfacing old, well-compacted roadways, it is desirable to place a thin layer of new 3 inch size stone on top of the old road bed before surfacing with Kyrock. The old road bed should not be sacrificed, if it is at all possible to true it up without doing so. That old base is solid because of its years of traffic and has more stability than can be secured by rolling after the bond has been broken.

The new top course for old road beds should be bound with screenings the same as for new construction. This work requires about 1000 tons of new stone per mile, and the same amount of Kyrock as for new construction.

New Incorporations

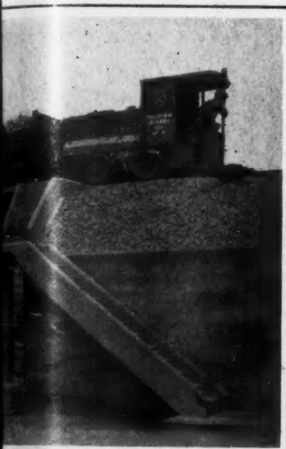
Palumbo Bros. Concrete Block Co., Rochester, N. Y. 500 shares $100 each, 250 common, no par. Enrico Palumbo, Cosimo Palumbo and Alfredo Palumbo, incorporators. (Attys. Bly & Bly, Rochester.)

The C. E. Harris Company, Boston, Mass. (hardware and building materials). Capital $25,000. Incorporators: Clifton E. Harris, Ethel L. Hartshown, both of Norwood; Max F. Kirschner, Watertown; Reginald H. Harris of Norwood.

Builders Cement Products Co. (sand, gravel and cement blocks). Capital $25,000. Incorporators: Leonard H. Earle, Elsie S. Earle, both of Medford, Mass., and Arthur L. Kirkpatrick of Woburn, Mass.

One of the Tremendous Storage Piles.

e Association Members Saw



A PARTY of prominent members of the National Crushed Stone Association, during the recent meeting of the Association's Mid-West Section, at St. Louis, made a trip over to see the new plant of the Columbia Quarry Co., at Krause, Ill.

They saw a mighty smooth-running plant, of all steel-concrete construction, with a number of new features that mark a distinct advance in the art of crushing, screening and handling stone. And they saw the part that Plymouths play in making the plant top-notch efficient.

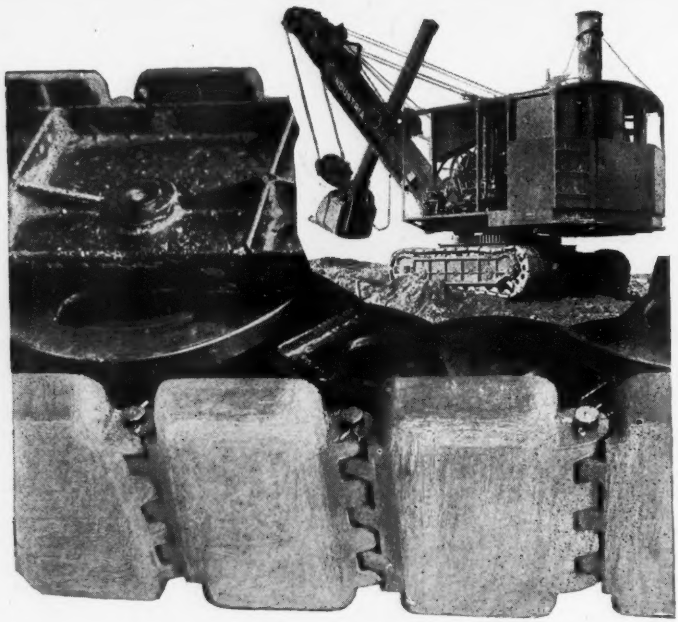
Five Plymouths are used at this plant with more to follow. Write us for handsomely illustrated rotogravure bulletin showing this remarkable plant and equipment in detail.

(P comotive Works)

PLYMOUTH, OHIO

OUTH

comotives



Aluminate Cement

Related Problems and New Investigations

By Hans Eisenback*

Part I

AMONG those fields in which other nations have excelled Germans is that of building materials, or more accurately limited, that of the cement industry. It appears that abroad and more especially in France, a new type of cement has been developed for which remarkable properties are claimed. This cement has been called "ciment fondu," "ciment electrofondu," etc.

Finally references appeared in German technical literature, and in the last few years various experimental data and articles about the new cement have been published. As these publications devote themselves each to some single problem and as the references are scattered through various periodicals, a complete review of all the problems relating to this new cement has been lacking. It is the purpose of this article to offer all the information hitherto available in complete form to a larger circle of readers and also to publish data on some new comprehensive investigations.

A. Chemical. All hydraulic cementing materials (if we neglect the dolomite cements with their limited application) consists principally of three components: lime, silica, alumina. For the sake of clearness we represent these hydraulic cements by means of the simple graph of the ternary system of these components, although we make the mental reservation that we are really dealing with a quaternary system as part of the alumina can be replaced by ferric oxide. To represent the regions within the ternary system where the individual types of cement lie we have chosen the Gibbs triangular coordinate system as shown in figure 1. It is an equilateral triangle in which each vertax represents one of the pure compenents. The lime vertex is occupied by 100 per cent CaO, etc. The sides of the triangle are divided into 100 equal parts, so that on these sides all the possible mixtures of the components taken, two at a time may be found. All mixtures composed of the three components of the system lie within the triangle, and may be read off so as to show the percentage composition represented, as it can easily be proved that the sum of the three lines parallel to the sides of the triangle drawn from any point within the triangle is equal to the length of the side of the equilateral triangle (or 100 per cent).

The ternary system $CaO—SiO_2—Al_2O_3$ was thoroughly investigated by G. A. Rankin in his classical research (Ztschr. anorg. allgem. Chemie 1915, vol. 92, p. 213). The compounds existing in this system, their melting points and optical properties, the boundaries between the various regions and the eutectic points were determined and represented by a concentration diagram. Within this triangular diagram the portland cement region lies toward the calcium silicate side, and though the question as to which is the active constituent of portland cement has not been settled beyond doubt, the hydraulic properties of portland cement can be safely ascribed chiefly to the compound $\beta—_2CaO.\ SiO_2$. That calcium aluminates also possess hydraulic properties was first shown by O. Schott in 1906 (Dissertation, Heidelberg, 1906). The Frenchman, Jules Bied, followed him with extensive researches in 1908, and then in 1910 the American Spackmann came along and his work was repeated by R. Killing (Protokoll des Vereins deutscher Portlandzement—Fabrikanten 1913). Then this new cement seemed to die out in Germany, probably because bauxite, the necessary raw material was not available from domestic sources in the quality desired, whereas in France it has already been on a production basis for some time. In Germany the problem was again attacked by K. Endell in 1919. Endell (Protokoll 1919) delimited the aluminate cement regions of the diagram and showed that the high strength values of aluminate cements were generally attained in the

*Translated by A. P. Sachs, Technical Director, Universal Trade Press Syndicate, exclusively for Pit and Quarry, from Chemiker Zeitung (German).

course of 24 hours. W. Gehler (Protokoll 1924) includes aluminate cements in 1924 in his proposed German cement standards and summarizes the most important data relating to aluminate cements published up to that time.

There are quite distinct differences in composition between portland cement and aluminate cement as the following table shows which gives the highest and lowest figures:

	Portland Cement	Aluminate Cement
CaO	61.5 to 67	35 to 45
SiO_2	20 to 28	5 to 10
Al_2O_3	4.5 to 9	35 to 55
Fe_2O_3	0.7 to 6	5 to 15
TiO_2	....	2 to 3

Aluminate cement as compared to portland cement is low in lime and high in alumina. Depending on this complete difference in composition there is an entire series of properties which distinguish aluminate cements from portland cements. They are:

1. High initial strength.
2. Resistance to corrosive waters.
3. Ability to harden at low temperatures.

In common with portland cement, aluminate cements have:

4. Constancy of volume.
5. Slow hardening.
6. Ability to stand storage.

B. Chemico-Physical Properties of Aluminate Cements. Lime and bauxite are used as the raw materials for the production of aluminate cements. Attempts to replace the relatively costly bauxite by clay itself have hitherto led to unsatisfactory results as clay contains too much silica, the removal of which by economical industrial methods is not at present possible. The mutual interaction of the raw materials is produced not by sintering as in the case of portland cement, but by complete fusion which is carried out either in an electric arc furnace or with coal in a water jacketed furnace. Hence we have the names for aluminate cement such as fused cement, ciment fondu and ciment electrofondu. We must not neglect to mention that preference is given by construction experts to the electrically fused aluminate cement.

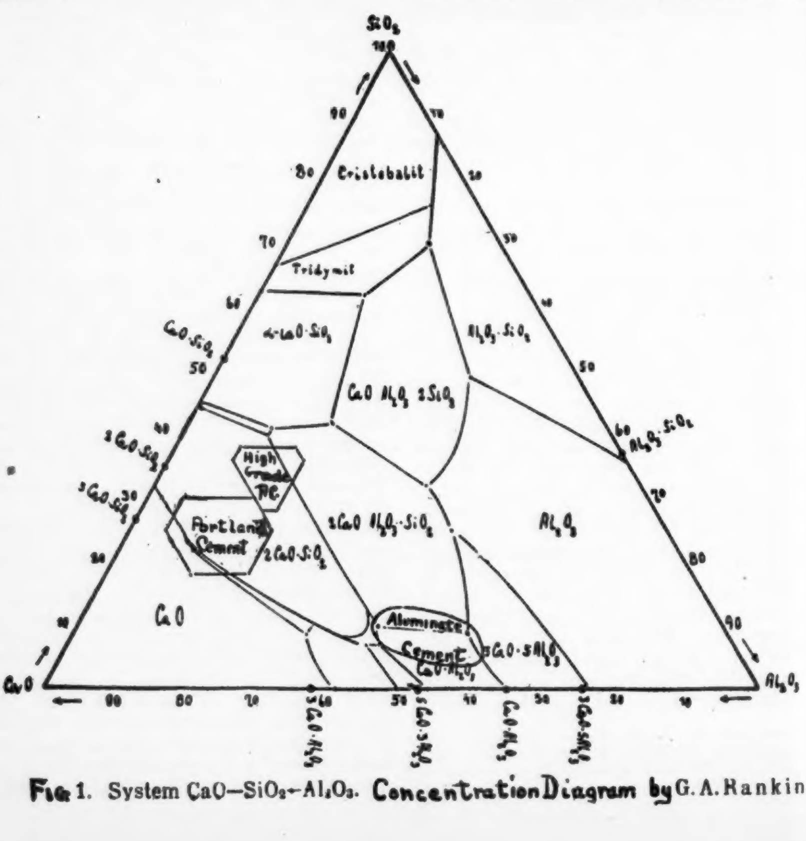


Fig. 1. System $CaO—SiO_2—Al_2O_3$. Concentration Diagram by G. A. Rankin.

The fusion naturally results in a complete interaction so that with correct proportion of lime a blowing of the cement due to underburning, etc., cannot occur; also gypsum blow-holes are impossible. The melting point of the crude mixture, depending on its composition, lies between 1400 and 1500 degrees C. The lower refining limit given by R. Killig who is in agreement with O. Schott is for pure lime cements the composition 5 CaO_3 Al_2O_3 containing 57.8 per cent CaO.

1. High Initial Strength. As mentioned above high initial strengths are among the chief advantages of aluminate cements. While in the case of portland cement (using a commercial German portland cement purchased in the open market; although sold as ordinary portland cement it has high strength properties) the hardening curve reaches about 250 kg cm^2 within one day and then rises slowly, the rise of this curve in the case of aluminate cement reaches twice this figure or more in the first 24 hours and then pursues a flatter curve parallel to the portland cement curve. The hardening is not completed during this first rapid reaction, but rather there is a slow long enduring after-hardening. In the following Table I we show the compression and tension strength values for aluminate cements of various origins (German aluminate cement known as Alca-fused cement manufactured by the Electrozement-Gesellschaft of Berlin, and French aluminate cement known as Al-Cement Lafarge).

It appears immediately from Table I that the compression strengths after 24 hours are already far in excess of the compression strengths of 250 Kg/cm^2 required for portland cement after 28 days, and in some cases are more than double this figure. Also at the end of 28 days the final strength values of the aluminate cements far exceed those usually obtained for portland cement. On the other hand the tensile strength does not increase in the same ratio as the compression strength; in fact they are in some cases inferior in this respect to port-

TABLE I

Compression and Tension Strengths in Kg / cm^2 in 1:3 mixture with standard sand

Kept	German Aluminate Cement						French Aluminate Cement	
	Comp.	Tens.	Comp.	Tens.	Comp.	Tens.	Comp.	Tens.
24 hrs. moist box	524	29.5	425	31.8	405	28.7	377	24.5
1 day air, 1 day water	641	43.3	422	26.3	362	24.9	459	27.7
1 day air, 6 days water	669	43.9	527	27.4	477	27.7	567	31.5
1 day air, 27 days water	800	49.0	559	28.0	518	29.5	616	33.4
1 day air, 6 days water, 21 days air	822	48.2	668	38.3	611	54.5	636	40.7

Analyses	German Aluminate Cement			French Aluminate Cement
SiO_2	9.54	7.36	6.78	9.43
TiO_2	2.42	2.00	2.12	1.46
Fe_2O_3	6.28	5.78	10.98	7.87
Al_2O_3	40.65	44.39	37.86	40.66
CaO	38.80	38.00	39.48	39.55
Insoluble in HCl	2.31	2.40	2.78	0.78

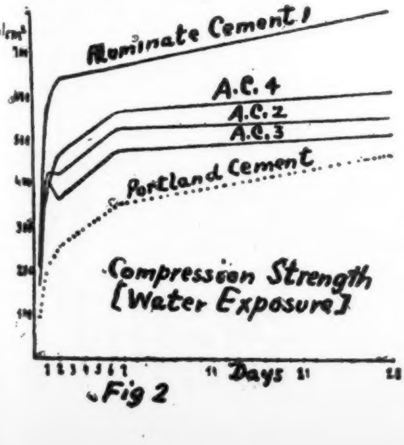


Fig 2

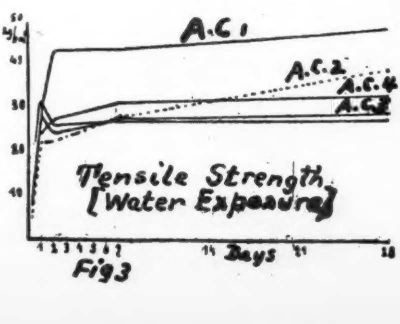


Fig 3

TABLE IV

Cementing Strengths of Various Elements Toward Each Other 1 Cement: 3 Standard Sand, Water, Air and Combination Storage (W, A, and C)

Age of the Basic Shape: 24 HOURS

Basic Shape	Attached Material	1 W	1 A	3 W	3 A	7 W	7 A	28 W	28 A	28 C	56 W	56 A	56 C	90 W	90 A	90 C
Alca	Alca	13.0	6.2	13.0	5.7	12.7	8.8	18.4	6.6	22.1	16.0	10.8	21.8	14.6	6.7	18.4
Portland	Portland	9.5	5.3	13.6	7.3	16.8	13.7	18.4	11.5	22.7	23.1	10.8	17.4	25.3	9.4	6.0
Iron Portland	Iron Portland	7.4	5.3	11.5	7.9	11.5	12.4	19.5	11.4	23.9	21.8	10.4	7.8	22.6	14.6	15.6
Blast Furnace	Blast Furnace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portland	Alca	6.3	4.9	6.8	4.9	7.7	5.2	9.0	5.8	13.8	10.5	7.0	8.8	10.7	4.3	7.5
Iron Portland	Alca	9.6	5.8	7.4	7.9	8.9	8.3	13.3	7.8	13.4	15.1	7.6	11.9	15.7	7.4	14.4
	Portland	6.0	2.9	12.1	10.3	15.7	11.4	22.8	13.6	26.3	22.8	7.9	23.3	20.1	9.0	23.2
Blast Furnace	Alca	—	—	—	—	—	—	—	—	—	—					
	Portland	—	—	—	—	—	—	—	—	—	—					
	Iron Portland	—	—	—	—	—	—	—	—	—	—					

Age of the Basic Shape: 3 DAYS

Basic Shape	Attached Material	1 W	1 A	3 W	3 A	7 W	7 A	28 W	28 A	28 C	56 W	56 A	56 C	90 W	90 A	90 C
Alca	Alca	8.4	5.9	9.7	9.1	11.5	3.7	12.4	5.4	12.6	10.1	5.1	13.5	10.0	5.5	11.4
Portland	Portland	4.3	3.1	6.2	3.5	10.7	4.4	16.9	4.3	5.5	9.7	3.3	3.6	10.2	4.1	6.8
Iron Portland	Iron Portland	5.1	4.9	8.4	9.3	8.4	10.8	19.0	7.3	13.9	19.9	0	8.9	17.5	10.3	11.9
Blast Furnace	Blast Furnace	0	0	3.0	4.0	6.5	8.9	26.8	9.7	17.6	28.7	9.7	20.8	27.3	8.5	17.3
Portland	Alca	4.5	2.7	7.3	4.2	7.0	4.0	9.6	5.6	9.4	7.6	4.3	5.6	6.8	4.6	9.8
Iron Portland	Alca	6.7	5.6	9.6	5.0	11.2	5.4	9.0	4.4	11.5	12.4	5.2	17.5	14.7	5.3	12.1
	Portland	4.8	2.8	6.9	5.5	9.5	5.4	12.8	3.5	6.2	15.0	4.8	13.8	22.1	4.9	9.5
Blast Furnace	Alca	—	—	4.0	4.5	6.6	5.8	6.3	3.1	5.8	8.4	3.2	6.0	8.3	5.4	5.6
	Portland	—	—	5.7	5.6	9.8	9.7	13.0	9.9	10.3	17.7	8.6	9.4	16.1	6.5	8.3
	Iron Portland	—	—	6.6	3.8	15.7	9.1	17.3	8.7	14.8	20.3	9.8	12.8	19.7	10.2	10.9

Age of the Basic Shape: 7 DAYS

Basic Shape	Attached Material	1 W	1 A	3 W	3 A	7 W	7 A	28 W	28 A	28 C	56 W	56 A	56 C	90 W	90 A	90 C
Alca	Alca	3.8	6.0	12.3	9.8	13.5	3.6	12.4	4.5	12.4	12.7	3.4	16.6	12.7	3.4	16.9
Portland	Portland	5.0	2.7	5.6	3.8	6.1	4.8	6.0	3.9	6.5	6.6	3.0	6.5	9.4	3.2	16.9
Iron Portland	Iron Portland	6.9	3.1	7.7	4.9	8.9	5.9	13.6	5.8	8.0	16.5	6.2	8.0	13.6	6.0	9.4
Blast Furnace	Blast Furnace	2.4	0	3.6	3.3	8.4	5.0	13.5	3.3	10.2	17.3	3.1	5.4	21.6	2.9	4.9
Portland	Alca	3.4	3.1	4.7	1.7	7.2	3.2	7.5	3.8	5.2	8.4	3.6	4.9	11.6	3.3	3.7
Iron Portland	Alca	5.9	3.5	4.4	5.5	5.7	4.9	9.9	4.6	5.0	8.0	3.9	6.9	10.8	4.2	6.2
	Portland	3.0	3.5	5.5	3.7	8.8	4.3	12.1	4.8	7.2	15.1	5.6	9.3	20.4	4.8	6.4
Blast Furnace	Alca	3.3	3.1	5.5	2.7	4.3	0	5.4	0	0	4.9	0	2.8	6.5	3.1	6.6
	Portland	3.7	2.7	4.3	4.4	9.8	0	8.8	2.8	3.4	9.1	2.9	0	14.2	3.1	3.2
	Iron Portland	4.5	2.6	5.8	7.6	9.2	6.6	13.5	3.6	5.4	7.0	6.5	6.5	12.9	3.8	6.4

Age of the Basic Shape: 28 DAYS

Basic Shape	Attached Material	1 W	1 A	3 W	3 A	7 W	7 A	28 W	28 A	28 C	56 W	56 A	56 C	90 W	90 A	90 C
Alca	Alca	4.5	0	7.5	6.5	8.5	5.4	10.6	4.2	13.9	7.0	0	9.3	13.1	3.2	12.9
Portland	Portland	7.1	4.1	9.8	11.3	13.6	11.1	17.3	8.0	18.9	23.3	7.2	11.2	25.3	5.3	13.5
Iron Portland	Iron Portland	5.8	3.5	9.7	5.7	9.2	4.8	17.3	7.2	20.9	19.7	8.5	17.4	24.4	2.4	17.9
Blast Furnace	Blast Furnace	3.4	0	6.8	0	12.4	3.9	11.6	5.6	9.4	13.1	5.8	8.2	20.2	4.7	7.8
Portland	Alca	12.4	4.1	11.9	6.1	13.0	5.5	21.2	6.1	11.6	12.0	4.3	6.8	14.0	4.6	9.1
Iron Portland	Alca	2.9	3.6	3.8	4.4	6.5	3.6	5.2	4.1	6.5	6.9	4.2	8.7	8.3	4.8	5.8
	Portland	8.9	5.9	7.9	3.9	7.4	5.9	10.6	5.0	17.7	15.1	4.9	10.7	23.0	4.1	8.7
Blast Furnace	Alca	4.2	4.8	5.6	4.0	3.9	2.9	4.7	3.3	4.9	5.1	3.6	3.1	5.7	3.0	3.3
	Portland	7.9	5.1	9.5	3.5	15.3	4.3	18.2	5.5	8.5	19.8	4.8	9.6	18.8	3.7	8.2
	Iron Portland	6.5	4.5	9.6	5.7	9.9	6.9	14.8	6.9	11.4	17.0	6.2	8.3	9.3	5.7	10.2

land cement. It is furthermore obvious tfrom Table I and figures 2 and 3 that in certain cases a drop occurs from the compression and tension strength figures as determined at the end of the first day, especially after exposure to water; but this drop soon ceases and after 7 days continuously increasing values are observed for the strength properties. This property of aluminate cements must be pointed out particularly in order to counteract the impression that the initially high strength values are followed by a continuous drop until finally practically no strength at all remains. The question as to what causes the inferior tensile strength and the drop in strength values between the first and seventh days has not yet been satisfactorily answered. The analyses given in Table I seem to indicate that a definite chemical composition corresponds to maximum strength values. Comprehensive researches to settle this question are in progress and will be published at a later date.

The remarkably high compression strength values after 24 hours made it probable that aluminate cements would show considerable strength immediately after setting. Experiments to answer this question were carried out by subjecting a series of samples to test at five hour intervals, beginning five hours after mixing. The test pieces had set by this time. The results of these tests were as follows:

TABLE II 1:3 Standard Sand

Time of Test	Compression	Tension
5 hours after mixing......	259	21.0
10 hours after mixing......	474	28.3
15 hours after mixing......	510	29.2
20 hours after mixing......	539	28.9
24 hours after mixing......	573	34.5

The figures given in Table II and figure 4 show the general indications only, as so violent a hardening would cause a slight difference between the setting time and the testing time to be of great importance, and such differences in time are actually caused by the fact that mixing and testing do take considerable time so that the indicated test interval cannot be strictly maintained. In spite of this difficulty the approximate course of the curve is clear enough. It shows that the compression strength of an aluminate cement after 10 hours from the time of mixing is at least as high as the standard requirements for portland cement after 28 days. This fact is of extreme importance in practice.

In order to obtain an idea to what extent the compression strength values and particularly the high initial strength values are altered with increasing leanness of the aluminate cement in the concrete, the following tests were made: Test pieces 7.1 cm on an edge were made in the hammer apparatus and then exposed for 1 day in the moist box and then exposed to the air. Tests were made on these pieces at the standard times and the

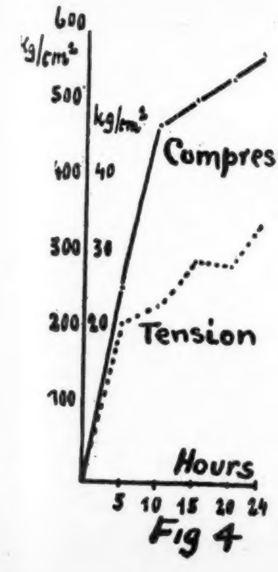


Fig 4

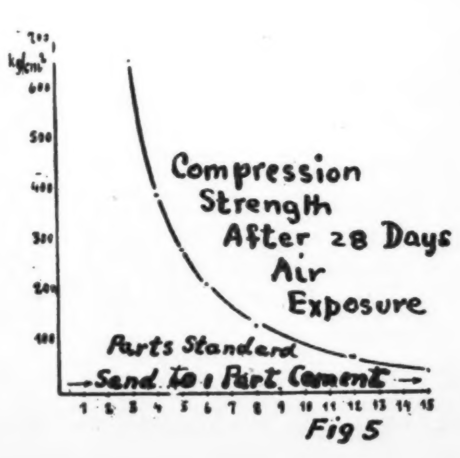


Fig 5

cement was thinned down with normal sand as far the 1:15 ratio. Although these experiments do not correspond to practice as concrete blocks show higher strength values, nevertheless an indication is given as to the behavior of aluminate cements in lean mixtures. The results of these tests are represented in Table III and figure 5.

TABLE III Aggregate : Standard Sand

Mixture ratio	1:3	1:4	1:5	1:6	1:7	1:8	1:12	1:15
24 hours	454	259	161	157	100	76	21	24
2 days	510	349	215	180	128	94	34	25
7 days	560	377	268	172	149	108	39	39
28 days	661	392	284	215	142	132	72	42

In figure 5 the mixture ratios are given as abscissas and the corresponding strength values as ordinates for the values determined at the end of 28 days for each ratio. Even though the conditions of the experiment do not correspond to practice as concrete is either stamped or poured, nevertheless fair comparisons can be made with standard tests on other cements and they furnish an inference as to the ability of a cement to tolerate thinning out. It may be concluded from the smooth curve that the limit for thinning out aluminate cements lies at about 1:5 if a compression strength of 250 kg/cm² is required in practice at the end of 28 days.

On the basis of the information obtained from the above mentioned experiments a practical construction test was made, a wall 2.50 meters long, 2 meters high and 6 cm thick being made of ferro-concrete using aluminate cement. The reinforcement consisted of ¼ inch iron rods 50 cm apart. The following ratios were used:

a 1 part cement to 10 parts gravel.
b 1 part cement to 15 parts gravel.
c 1 part cement to 20 parts gravel.

The walls were poured and removed from the molds 24 hours later; on striking with a hammer they gave a clear, pure sound and hardening was perfect.

In order to compare the behavior of aluminate cements to that of other types of cement a large series of tests was undertaken, and the main point stressed was to obtain a comparison of the cementing properties of the various kinds of cement. The tests were carried out on test pieces with a 1:3 mixture ratio with standard sand and the following procedure was used: First a so-called basic shape was made of the variety of cement being tested. The mixture made in the standard manner was filled into the regular molds for tensile strength test pieces by means of the hammer apparatus, but at the narrowest point of the form a thin sheet of metal extending across the entire cross-section was inserted so that on removing the form the test piece came out in two equal portions without any difficulty. These halved test pieces were the basic shapes. After the desired time such a basic shaped after being moistened with water was put back into the mold and the missing half was added by filling in with the hammer apparatus a standard mixture of some other kind of cement. No absolute values are obtainable in this manner; but a comparative set of figures is obtainable as is conclusively proved by the perfectly comparable treatment and the large number of results. The results of these tests are given in

In discussing the data of Table IV and the corresponding graphs it should first be noted that the experimental conditions are extremely sharply defined in a manner not attained in practice. Cementing occurs at a smooth surface which has in no way been prepared, having been neither scraped nor roughened, but only moistened with water, and furthermore the cementing surface is very small as the tensile strength test pieces have a cross-sectional area of only 5 cm² at the narrowest part. There is therefore no justification for far-reaching conclusions from these tests as the relationships in practice are far more favorable, but certain valuable conclusions can be drawn from the data so that disappointments in practical work can be avoided. It appears quite generally that the smallest cementing strengths occur after air storage while they are rather better for water storage and for the so-called combination storage. This means that in construction work where cementing values are involved as for instance in surfacing some type of combination hardening should be selected; in this case the structural parts should be kept throughly moist for the first 7 days. Furthermore it is evident from Table IV that aluminate cement adheres to portland cement without any danger whatsoever though the strength obtained is relatively lower than when two cements of the same kind are joined. However no mutual decomposition of aluminate and portland cement occurs, but the portland cement should be thoroughly

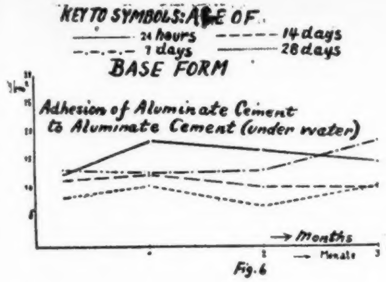


Fig. 6

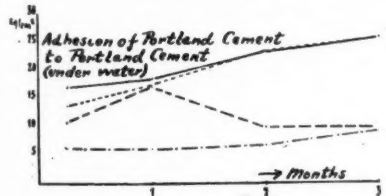


Fig. 7

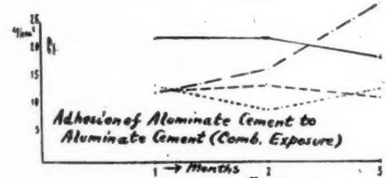


Fig. 8

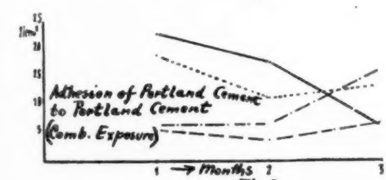


Fig. 9

set before aluminate cement is applied.

The best results are obtained with portland cement on portland cement with water exposure, but only if the basic shape has been exposed either only for 24 hours or after 28 days. But if the basic shape is only 3 days old, a very fine initial increase in strength occurs, but just as rapid a subsequent drop follows. If the basic shape is 7 days old the strength values are small but increase slowly. An explanation of this remarkable behavior may lie in the fact that a basic shape only 24 hours old is still fresh enough and the hardening of the portland cement has proceeded to so small an extent that a perfect union with the newly attached material is still possible, so that the basic shape is not affected by any stresses resulting from liberated energy of hardening. On the other hand portland cement 3 to 7 days old is just in the chief course of hardening when there is a transition from the sol-condition to the gel-condition and further in the crystalline condition instead of being subjected to simultaneous intergrowing of crystals. As a result stresses appear in the basic form which hinder the adhesion of the more recently applied cement. When the basic form reaches an age of 28 days the final condition of hardening has been attained approximately and only a slow increase in strength values occurs; the stresses have gradually adjusted themselves, so that now again a good adhesion of the new material is possible.

The conditions are quite similar in the case of aluminate cement although the phenomena are displaced with respect to time. It gives up its energy of hardening practically completely in the first two days in which naturally the largest stresses appear. As a result we observe in this case a curve of cementing strength to a basic form 24 hours old similar to that for portland cement 3 to 7 days old. But if the aluminate cement basic form is 3 days old the drop in values is only very slight, and at an age of 7 days for the basic form a continuous and slow increase in strength values appears. It is remarkable and not yet definitely explained that the adhesion to a 28 day old aluminate basic form decreases appreciably. It must be assumed that the basic form in this case is to be considered as old so that an intimate bond can be produced only with the greatest difficulty. The French manufacturers have taken this property of aluminate cements into account by stating in their directions that the basic concrete should have as rough a surface as possible and that it should be thoroughly brushed and washed.

As these experiments do not permit a final conclusion with respect to the problem of the behavior of the various cements towards each other, but are rather to be considered as a preliminary orientating collection of rata, further comprehensive tests are being planned which will naturally require considerable time before the results are ready for publication.

2. Resistance to Corrosive Solutions. As has already been pointed out aluminate cements are to be considered as low in lime in comparison with portland cements and conse-

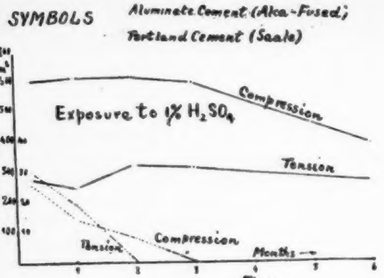


Fig. 10

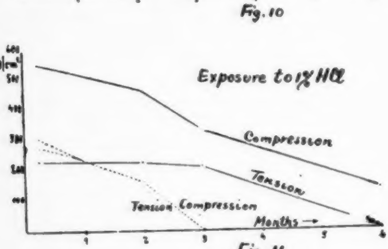


Fig. 11

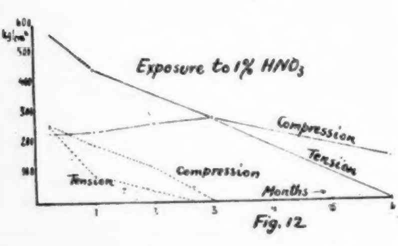


Fig. 12

quently they are less sensitive to many solutions than are portland cements. Naturally no absolute resistance toward acids is to be expected of aluminate cements; for their chief component calcium aluminate is a compound which can be decomposed by acids. It is a questions only of how much less aluminate cements are attacked by acids than are portland cements and other cements.

For the purposes of test an aluminate cement of German origin and an ordinary portland cement were obtained in trade channels. In the case of the aluminate cement, no especially selected good brand was chosen, as appears from the figures for strength on exposure to water, but the differences are to be ascribed to the "aluminate" type to which this cement belongs.

The experimental procedure was as follows: Test pieces were made of 1 part cement and 3 parts standard sand in the form of cubes 7.1 cm. on an edge in the hammer apparatus; they were placed in large stoneware pots and completely covered by the solution being tested. In order to avoid any diminution in strength of solution due to impoverishment of the solution at the surface of contact with the test pieces, the contents of the pot were stirred thoroughly twice a day and the salt solutions were renewed every 4 or 5 days, while the acid solutions were maintained at constant strength by analysis from time to time.

The tests provide a maximum of unfavorable conditions as small test bodies have a relatively large surface. In case of any action, at least with acids and bases, we are dealing with solubility phenomena in which the magnitude of the active surface is extremely important. In practice the ratio of surface to weight will be much smaller so that the resistance of the cement will be greater.

Acids. The results of exposure in acids are summarized in Table V and figures 10 to 12. As appears clearly from figure 10 aluminate cement is attacked by 1 per cent sulfuric acid much less than is portland cement; for while portland cement test pieces after 2 to 3 months exposure to 1 per cent sulfuric acid were rendered so fragile that a determination of

TABLE V
Exposure of Test Pieces to Acids 1 Cement: 3 Standard Sand

Solution	C—Compression T—Tension	Water C	Water T	1% H_2SO_4 C	1% H_2SO_4 T	1% HCL C	1% HCL T	1% HDN_3 C	1% HDN_3 T	5% Oxalic Acid C	5% Oxalic Acid T	5% Oxalic Acid C	5% Oxalic Acid T
Time of Hardening	Type of Cement												
2 days 1 Air + 1 Water	Alca	503	23.7	543	26.5	433	22.9	508	21.9	509	28.6	484	31.0
	Portland	256	22.8	...	...	...	...	...	...	...	...	...	...
7 days 1A + 6W	Alca	594	25.0	606	27.7	555	23.1	574	23.3	583	28.2	493	32.3
	Portland	352	28.0	259	30.3	309	27.9	264	25.7	272	34.2	274	26.0
28 days 1A + 27W	Alca	611	25.1	616	24.6	474	23.7	448	24.0	594	29.5	159	25.8
	Portland	458	39.4	140	19.0	237	23.4	194	9.2	347	35.3	234	20.3
56 days 1A + 55W	Alca	620	23.6	613	32.4	466	22.8	...	26.3	535	29.4	...	...
	Portland	451	40.7	79	0	161	16.3	119	3.8	409	37.2	160	0
90 days 1A + 88W	Alca	626	30.0	596	31.5	335	21.6	283	28.0	703	35.0	105	0
	Portland	452	41.7	20.1½	20.2¾	0	0	0	0	370	39.0	0	0
180 days 1A + 179W	Alca	706	28.3	390	26.6	136	0	145	...	724	42.2	0	0
	Portland	507	41.3	0	0	0	0	0	0	380	40.2	0	0

their strength became impossible, aluminate cement under similar conditions at the end of six months had a compression strength of 390 Kg/cm^2 and a tensile strength of 26.6 Kg/cm^2. The appearance of the test pieces indicated that the corrosion was only a slow surface solution and that blow phenomena which disintegrate the whole piece did not occur. The fracture of the ruptured pieces showed always a perfectly dense, unattacked surface. It can safely be stated that aluminate cement resists the action of free sulfuric acid much longer than portland cement under similar conditions. The data are not so favorable in the case of exposure to 1 per cent hydrochloric acid (figure 11) and 1 per cent nitric acid (figure 12). But even here aluminate cement is much more resistant than portland cement, but in a lesser degree than toward sulfuric acid. In these cases we can expect of aluminate cement only twice the life of portland cement. Aluminate cement in comparison to portland cement is attacked most strongly by 5 per cent acetic acid as both cements are destroyed after 2 or 3 months. This is to be expected on account of the high affinity for acetic acid both of lime and of alumina and on account of the high solubility of both the salts formed. Aluminate cement is not attacked by 5 per cent oxalic acid.

Alkalis. Tests on the resistance of aluminate cement to basic solutions were carried out by exposing test pieces to 1 per cent NaOH, saturated $Ca(OH)_2$ and gas water with approximately 1 per cent free and semi-combined NH_3. The results are summarized in Table VI and figures 13 and 14.

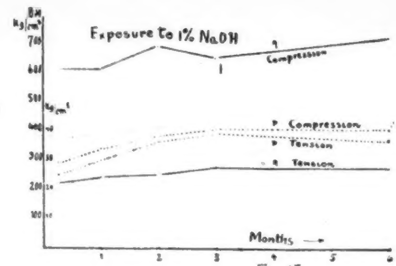


Fig. 13

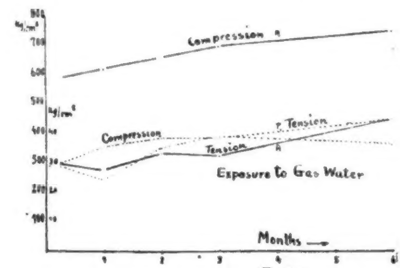


Fig. 14

The variations in compression strength of portland cement on exposure to 1 per cent NaOH are particularly surprising and although at the end of a test period of half a year no important diminution in compression or tensile strength occurs, nevertheless it can be safely assumed that aluminate cement will not permanently resist attack by alkaline solutions but will suffer a solvent action due to the formation of alkali aluminate. This view is supported by the published results of Haegermann and Hart (Zement 1925, vol. 14, page 204) who found a solvent effect on alumina when aluminate cement powder was treated with caustic alkali. On the other hand no corrosion occurs on exposure to saturated milk of lime nor to gas water containing about 1 per cent of free and half bound ammonia. In fact the am-

TABLE VI
Exposure of Test Pieces to Alkalis 1 Cement: 3 Standard Sand

Solution		1% NaOH C	1% NaOH T	Milk of Lime (Saturated) C	Milk of Lime (Saturated) T	Gas Water C	Gas Water T
Time of Hardening	Type of Cement						
2 days 1A + 1W	Alca	582	25.2	529	26.6	525	28.9
	Portland	...	...	...	...	...	...
7 days 1A + 6W	Alca	615	22.0	562	24.6	596	30.0
	Portland	295	25.3	349	32.1	304	29.0
28 days 1A + 27W	Alca	611	24.6	633	24.5	622	27.9
	Portland	341	30.1	416	35.2	357	24.2
56 days 1A + 55W	Alca	693	25.1	710	26.3	661	33.5
	Portland	386	36.4	460	37.5	388	35.2
90 days 1A + 89W	Alca	654	27.9	723	30.5	702	32.7
	Portland	408	39.3	503	37.6	391	39.2
180 days 1A + 179W	Alca	729	27.6	807	34.4	725	45.3
	Portland	410	37.5	438	40.2	451	36.7

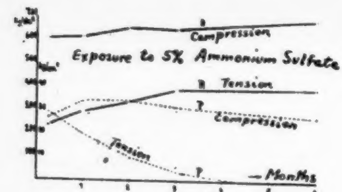


Fig 15

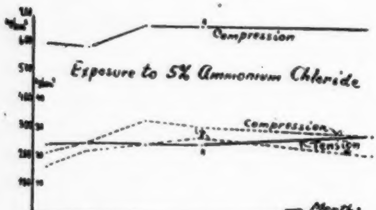


Fig 16

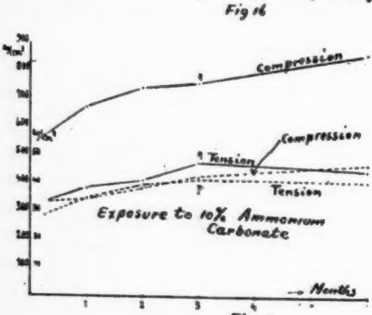


Fig 17

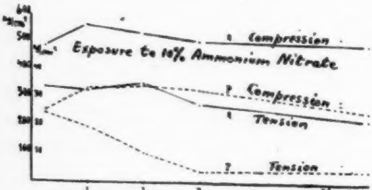


Fig 18

monium salts in solution in the gas water seem to produce a strengthening effect on the aluminate cement.

Ammonium Salts. As the literature has recently contained reports (Zement, 1925, vol. 14, page 185) on the corrosion of portland cement by ammonium salts, experiments were conducted to investigate this action by exposing aluminate cement test pieces in 5 per cent ammonium sulfate, 5 per cent ammonium chloride, 10 per cent ammonium carbonate and 10 per cent ammonium nitrate solutions. The results are shown in Table VII and figures 15 to 18.

The results on exposure to 5 per cent ammonium sulfate are quite surprising; for while the tensile strength of portland cement dropped to 3.5 kg/cm² after an exposure of 3 months, both the compression and tensile strengths of aluminate cements increased to reach values of 695 Kg/cm² and 39.8 Kg/cm² respectively after 6 months. Blow phenomena which manifest themselves at once in the strong and constant drop in the tensile strength of the portland cement do not occur at all in the case of aluminate cement. Whereas after 180 days of exposure to the solution the portland cement test pieces are peeling and disintegrating the tensile test pieces being actually broken through, the aluminate cement test pieces after 308 days seem fresh and clean edged and no trace of blowing. Also on exposure to 5 per cent ammonium chloride there is a continuous increase or at least no decrease in the strength values of the aluminate cement, whereas in the case of portland cement after 2 or 3 months there is a slow drop in strength values. Exposure to 10 per cent ammonium carbonate produces a constant, large

TABLE VII (1 Cement: 3 Standard Sand)

Action of Ammonium Salt Solutions

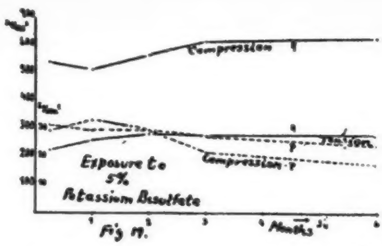
Solution / Time		5% Ammonium Sulfate C	5% Ammonium Sulfate T	5% Ammo- Chloride C	5% Ammo- Chloride T	10% Ammo- Carbonate C	10% Ammo- Carbonate T	10% Ammo- Nitrate C	10% Ammo- Nitrate T
2 days	Alca	488	25.3	514	23.2	562	28.8	469	32.7
1A+ 1W	Alca	...	...	...	...	...	...	...	...
7 days	Alca	609	23.6	601	24.7	667	33.6	488	34.0
1A + 6W	Alca	267	28.8	217	16.9	288	33.3	257	24.5
28 days	Alca	614	29.2	593	25.2	673	38.4	566	33.0
1A + 27W	Alca	333	19.5	259	22.8	348	34.5	338	19.8
56 days	Portland	653	33.7	672	25.3	741	41.1	533	35.7
1A + 55W	Portland	340	9.8	334	26.1	384	39.7	347	10.6
90 days	Portland	649	38.9	671	25.2	760	47.7	504	27.7
1A + 89W	Portland	315	3.4	312	27.7	426	41.8	331	3.8
180 days	Portland	696	39.8	672	29.9	871	45.2	492	22.3
1A + 179W	Portland	278*	0*	294	22.7	476	41.3	253	4.8

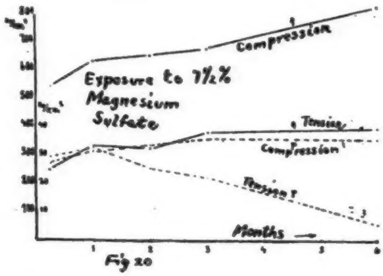
*Blown

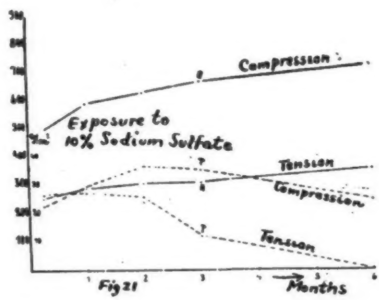
increase in compression strength of aluminate cement so that in 6 months time 871 Kg/cm² is attained while the tensile strength drops from 41.8 after 3 months to 41.3 Kg/cm² after 6 months.

The results are very unsatisfactory, however, in the case of exposure to 10 per cent ammonium nitrate, for here the aluminate cement shows a constant drop in strength values after a short time. Although aluminate cement held out better than portland cement which after three months had a tensile strength of only 3.8 Kg/cm², nevertheless in this particular case aluminate cement is not to be considered as resistant.

Sulfates. Both in the French and in the German technical literature one of the chief advantages of aluminate cement is considered to be its resistivity to water containing sulfates. It has already been shown that aluminate cement is much more resistant to free sulphuric acid than is portland cement and that not only is it not corroded by 5 per cent ammonium sulfate but that the latter actually seems to increase the strength values of aluminate cement. In order to obtain a more complete picture of the effects produced by sulfate solutions on aluminate cements as compared to portland cement test pieces were immersed in 5 per cent potassium sulfate, 10 per cent sodium sulfate, 7½ per cent magnesium sulfate and saturated calcium sulfate solutions. The results are given in Table VIII and figures 19 to 21. In none of these is there any evidence of corrosion of aluminate cement by the solutions, whereas corrosion of portland cement is evidenced by a drop in strength values especially in the tensile strength. The aluminate cement samples were exposed 302 days, while the







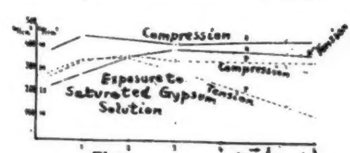


TABLE IX (1 Cement : 3 Standard Sand)

Action of Chloride Solutions

Solution		Sodium Chloride 10%		Calcium Chloride 10%		Magnesium Chloride 33°Bé.	
Time		C	T	C	T	C	T
2 days 1A + 1W	Alca	538	23.5	500	24.7	461	27.3
	Portland	...	...	...	...	...	...
7 days 1A + 6W	Alca	601	23.0	559	29.6	475	25 4
	Portland	307	28.3	242	25.3	263	33.5
28 days 1A + 27W	Alca	657	22.8	594	31.3	542	32 1
	Portland	383	33.0	271	29.7	323	29.7
56 days 1A + 55W	Alca	712	26.2	684	34.9	616	38.2
	Portland	406	31.7	369	29.8	407	32.6
90 days 1A + 89W	Alca	759	24.6	694	36.9	685	43.3
	Portland	442	29.6	357	35.0	383	31.1
180 days 1A + 179W	Alca	846	26.5	773	36.4	814	41.7
	Portland	468	30.5	391	26.3	419	24.7

portland cement samples were exposed only 202 days. As was to be expected from the graphs the Alca test pieces have smooth surfaces and sharp edges and are perfectly unattacked while the portland cement blocks are blown and show warped edges and blow cracks.

TABLE X Action of 5% of Sodium Carbonate

Time	Kind of Cement	C	T
1A + 1W	Alca	488	24.3
		...	...
7 days	Alca	536	27.6
1A + 6W	Portland	317	27.0
28 days	Alca	606	25.3
1A + 27W	Portland	379	33.6
56 days	Alca	589	24.7
1A + 55W	Portland	433	36.4
90 days	Alca	530	26.4
1A + 89W	Portland	478	36.8
180 days	Alca	447	15.7
1A + 179W	Portland	499	43.5

There are numerous reports in the literature on the resistance of aluminate cement towards gypsum and sea water. Thus Anstett (Revue des Matériaux de Construction et de Travaux Publics, 1923, #162) reports on experiments to test the resistance to calcium sulfate. He prepared test blocks of pure cement, allowed them to harden for a week, crushed them to powder so that all of it passed a 4900 mesh (70 meshes per cm.) screen; he crushed gypsum in the same manner. He prepared a mixture of these powders containing a 50 per cent gypsum and molded small cylindrical blocks at a definite pressure. These blocks were exposed to an atmosphere saturated with moisture and were covered with a sheet of filter paper, one end of which dipped into a vessel of water. The whole was covered with a bell-jar. Whereas with all other materials blistering and blowing occurred after several days, the aluminate cement alone remained unchanged and showed no interaction even after two years.

M. Féret (Ann. des Ponts et Chaussées, Juli-Aug. 1922) reports on the resistance of aluminate cement to sea-water. These tests covered a period of 5 to 10 years and even after this period no evidence of any corrosion appeared. Also in the German literature (Zement 1925, vol. 14, pages 205 and 319) there are reports of new tests along this line. In these cases also the inertness of aluminate cements toward sulfate waters and sea water was confirmed. To summarize it may be said that "Aluminate cement must be used wherever sulfate solutions in any form are involved."

Gravel Producers By Necessity

Hill and Belknap, of East Tawas, Michigan, built their sand and gravel plant at St. Ignace in the upper peninsula as a matter of necessity. They were awarded the contract for the construction of 57 miles of gravel road forming a part of the Roosevelt Highway and connecting the cities of Sault Ste. Marie, Munising and Marquette and there was no gravel plant in the eastern part of the upper peninsula supplying the materials desired.

Heavy demand of the road work during 1924 the first season took practically all of the output. The plant did some general business however and prepared to go into the general market actively after its road job was completed. The deposit is probably one of the most unusual in Michigan. The supply is almost unlimited and the pit they are working at the present time is a limestone deposit, 90 per cent of which is retained on a 14 inch screen and not more than 30 per cent has to be crushed to pass a 1 inch screen. The plant has a capacity of 800 yards daily of washed and screened gravel for concrete work.

The plant was designed by the Fred T. Kern Company of Milwaukee and all machinery was purchased through them. The firm uses an Erie steam shovel with a 1 yard bucket for digging out the material and loading it into 4 yard cars which are hauled to the plant over a 36 inch gauge track by a 7 ton Whitcomb locomotive. A number 4 Telsmith reduction crusher is used.

New Incorporations

Builders' Supply Company, Inc., (deal in building materials) Trenton, N. J. 2,500 shares, no par. Incorporators: Backes & Backes, Trenton, N. J.

The Merriman Asphalt Plant, Inc., Lima, Ohio. Capital $25,000 preferred, 250 shares no par value. Incorporators: A. B. Mayer, F. O. Seidell, H. M. McComb, Melvin C. Light and Edith Shwerdecker.

Rosso Concrete Block Corporation, Rockaway Beach, N. Y. Capital $20,000. Incorporators: A. Rosso, M. V. and J. R. Forte. Atty. B. Kohn, Rockaway Beach, N. Y.

L. A. Walsh, Inc., (deal in building materials) Newark, N. J. Capital $100,000. Gerald A. Caruso, incorporator.

Manganese Steel

Its Properties and Uses

By C. H. Sonntag

IN the ordinary simple steels with which we are all familiar the properties of any given piece as to hardness, tensile strength, ductility, etc., depend almost entirely on the heat treatment and mechanical working it has received and the amount of carbon it contains. This carbon content is of very great influence. Iron almost free from it is known as wrought iron or soft steel. As the percentage of carbon increases we get structural steel, tool steel and spring steel, and finally get out of the steel classification altogether and find ourselves dealing with the various forms of cast iron.

Steel depending on its content of carbon only for the determination of its properties is called carbon or simple steel, and forms the great bulk of the product of our rolling mills and steel foundries. It has been known for a long time that the addition of certain other elements, some of them rather rare, to iron has a profound influence on it. Some of these elements need to be added only in small quantities, while others are required in considerable percentages. The special steels used for high-class springs, automobile frames and transmission gears, propeller shafts in steamships, projectiles, transformer cores, high-speed metal cutting tools and similar applications all contain one or more elements other than carbon to better adapt them to the purposes for which they are used. They are all called alloy steels to distinguish them from simple carbon steel.

Composition

Manganese steel is one of these alloys. It has been known for many years that a small amount of manganese, usually about 1 per cent, in a simple steel tended to prevent brittleness at a red heat, but it was Sir Robert Hadfield, a British metallurgist, who in the early '80s studied the whole series of alloys of iron and manganese, and discovered and made public the unique properties which make it, in certain proportions, so valuable.

Commercial manganese steel as sold today contains from 11 to 14 per cent of manganese, 1 to 1¼ per cent of carbon, and fractional percentages of silicon and phosphorus, the balance being iron. The sulphur is practically zero, being eliminated by the manganese. Alloys with other percentages of manganese may be made, but they are not as valuable for general use as the one just cited. One containing 4 or 5 per cent of manganese is so brittle as to be readily pulverized by hammering, and no means of toughening it is known.

Properties

Manganese steel has found a definite place in industry because of its peculiar combination of extreme hardness and ductility. No other metal or alloy is known to have these together in the same degree. These attributes must be brought out by appropriate heat treatment, which consists of sudden quenching in cold water from a temperature of about 1920 degrees F. The raw steel as it is when first cast is very hard, but is also very brittle, and has practically no ductility. It can not be sent without breaking and will not stretch. After quenching the hardness is retained but a remarkable degree of ductility is also acquired. Hence the hardness is not like that of glass, for while the metal can not be cut or pierced, neither can it be shattered by a blow. In fact it can be nicked by a hammer or cold chisel, though the chisel can not be made to cut a chip from it. Yet in spite of this great hardness, which might perhaps be called toughness, a test piece 8 inches long will sometimes stretch 50 per cent of its length under direct tension before breaking.

In connection with the stretch or elongation another peculiar property of this alloy must be mentioned. For most metals, and in fact for other solid substances as well, there is a certain stress per unit cross-section known as the elastic limit. If the substance be stressed below this limit it will return to its original dimensions if the applied force is removed. If stressed beyond this limit a permanent deformation occurs, which remains on release of the stress. For most substances the elastic limit is quite definite, deformation being comparatively rapid when this point is exceeded.

The elastic limit of manganese steel is quite surprisingly low considering its high ultimate strength, and it is not a well-defined point, as deformation appears to be gradual and at an increasing rate under tension. In consequence this steel will flow or "mash" under low compression, and will also be easily deformed by repeated blows, even though these are comparatively light.

The product of the tensile strength of a substance by its elongation gives a number which is proportional to the work that must be done on a piece of the substance to break it in tension. This product may be called the "merit number" of the substance in question. Table I gives the tensile strengths, elongations, and merit numbers of several well-known steels. It will be noted that the merit number of manganese steel is higher than that of the others shown, and so far as present information goes the merit number of this alloy is greater than that of any other known steel.

Of course the values for manganese steel refer to the metal after it has undergone the quenching or toughening process. The great change thus brought about is shown in Table II The low elongation of the untreated metal shows its extreme brittleness prior to toughening. This process also nearly doubles the tensile strength, and there is hardly any comparison between the merit numbers pertaining to the two states.

Manganese steel has one other attribute that is rather surprising considering its composition. In spite of the fact that it is about seven eighths metallic iron it is practically nonmagnetic. It follows that if there is any question as to whether a certain piece of metal is manganese steel or not a common horse-shoe magnet or even a magnetized knife-blade will serve to make the test, since they will not be attracted to this alloy. For this reason manganese steel is not picked up by the lifting magnets used in scrap yards.

Commercial Forms

Manganese steel appears on the market either as castings or as forgings, including in the latter rolled sheets and rods as well as pieces worked under the hammer. The greater part of the tonnage is in the form of castings, and as this was also the earliest way in which this steel was extensively exploited we will take it up first.

Castings

One of the first uses to which Hadfield put his new steel was for the pins of ladder or chain-and-bucket dredges, which are extensively used in harbor work in England. Their success was immediate. While the first pins were forgings they were soon cast, and now the entire chain and buckets are made of this material. The dredges used in the western part of this country to work placer gravel for gold are extensive users of manganese steel in this way.

Shovel Dippers

Dipper dredges and steam shovels use the same type of bucket. The service demanded of the teeth and lips of these buckets is very severe, particularly in handling rock. Manganese steel was first used in renewable tips for the dipper teeth, and several designs have been worked out. Later, dipper fronts were made of this metal, and now for very hard service the whole bucket is cast of manganese steel, as well as the sheaves over which the chains run. These cast buckets have reversible and renewable teeth and sometimes renewable fronts.

Crushers

The linings for crushers, both jaw and gyratory, make a considerable market for manganese steel castings. The wear is usually much greater at the lower edge than elsewhere, and the liners of jaw crushers are made sectional so that only the worn part need be renewed. The same applies to the concaves of gyratories. Owing to its superior strength, plates made of manganese steel may often be made lighter than those of other metals, thus somewhat offsetting the higher price per pound.

The heads of large gyratories are very heavy, and if made entirely of manganese steel would be unnecessarily expensive. The larger part of the metal would not be used effectively, and a more economical arrangement is to surround the shaft with an inner head or core of cheaper metal over which a "mantle" of manganese steel is placed. The tendency to flow under pressure, previously noticed, causes the mantle to expand slightly and work down on the core, and crusher builders have devised means for automatically following up the mantle with the clamping nuts so that it will not turn on the core.

Chains and Sprocket Wheels

Elevator chains and buckets in severe service should be made of manganese steel. While the life of such a chain is very much longer than that of one made of malleable iron or carbon steel, nevertheless there comes a time, long before it is worn out, when looseness at the joints makes the chain too long pitch to run well on sprocket wheels with any considerable number of teeth. Fortunately most elevators will carry their load if the upper wheel has no teeth, being of the so-called traction type, driving by friction only. On such an elevator the pitch of the chain is of no importance, and a wonderfully long life may be obtained from it.

Manganese steel is also used for power transmission chains in the smaller sizes, such as No. 88 and No. 103. Transmission chains must run on sprocket wheels with teeth, and it has been the writer's experience that slight wear at the joints causes poor action on the wheels when the chain is not more than 30 per cent worn out. Turning the pins, if the chain has pins, and later renewing them, will prolong the life of the chain, but there is some question as to the real economy of manganese steel in such service as compared to the better types of hardened roller chains made of cheaper metal.

Sprocket wheels of this alloy may be made considerably lighter than those of cast iron because of the greater strength of the metal. They have a very long life, and a valuable feature is the fact that the working faces of the teeth acquire an almost mirror-like polish, so that friction and wear on the chain are minimized.

Dredge Pumps

An application that is of very great importance to sand and gravel operators is the use of manganese steel in centrifugal dredge pumps and fittings. Its value for this purpose lies in its combination of toughness and resistance to abrasion. The blows and shocks resulting from the passage of large pieces of gravel through a pump are sometimes severe, and may break the impeller or casing if they are made of brittle material. Abrasive wear on the runner and inside of the casing is excessive, as it is also wherever the stream of water and gravel changes direction, as at bends in the pipe line. In such service manganese steel has made a wide field for itself.

Clay-Working Machinery

The clay used in making brick and tile always carries much sand, and cuts away the machinery parts with which it comes in contact very rapidly. Of particular interest are the screws or augers of auger tile and brick machines, the dies through which the clay is forced on these same machines, and the blades or knives of pug mills. Some cement mills use pug mills in preparing the clay for mixing. The writer has used both forged carbon steel and cast manganese steel knives side by side in the same pug mill handling a mixture of clay and coal ashes. The carbon steel blades were useless in two weeks, while those of the more costly metal were in fair condition at the end of a year.

High-Speed Grinders

Attempts have been made to use manganese steel for the grinding rings of high-speed pulverizers, such as Fuller and Griffin mills. The writer is one of those that made this experiment. As far as abrasive wear was concerned, the service was superior to that of roller tire steel or high carbon cast steel, and not much different from that given by deeply chilled cast iron. The trouble was found in the inability of the manganese steel ring to maintain its dimensions. The pounding and rolling action of the heavy grinding balls or roll heads caused the ring to slowly increase in size, so that if held in a cast iron part of the mill there was danger of breakage. This use of manganese steel has apparently been abandoned. The same flowing action has caused trouble with ball mill grinding plates made of this metal.

Tube Mills

Service worth many times their cost may be had from manganese steel tube mill discharge screens. The founders have learned to cast them with the narrow slots needed, and if the mill is loaded with pebbles the life of the screens is almost indefinite. If iron or steel balls are used a peining action occurs which gradually closes the slots, and about once a year they must be opened by driving a wedge into them. Their life will be five or six years at least.

Swing-Hammer Mills

The hammers of these machines, especially in the larger sizes that take the product of large primary breakers or act as primary crushers themselves, are made of this same remarkable alloy, as are also the cage bars of these machines. For the hammers only enough ductility to prevent breakage is desired, and it is possible that the makers slightly modify the composition of the steel and its heat treatment in making these hammers.

Gears

One of the most important early uses of manganese steel was for coarse pitch cast tooth gears for rough service in dusty places where lubrication is difficult or impossible, and where there is the possibility of shocks that would break the teeth of cast iron gears. There are many places on steam shovels, in cement mills and about crushing plants where manganese steel gears are about the only ones considered.

In spite of this, there are many cases in which gears of this metal are not the most economical to use. One reason is that the teeth are usually cast, and so are not suited to high speed operation. Attempts to bring them to smooth and correct outline by grinding have been made, but the process is expensive. For gears of the finer pitches such as are used on cranes and in enclosed speed reducers machine cut gears of other alloy steels, properly heat treated, will give long life with the advantages of smooth operation and the ability to machine them to exact size.

Since manganese steel can not be worked with metal tools, any part of a casting that must be machined must be made of some other metal. Cast carbon steel is commonly used, a piece of the proper size and shape being placed in the mold before the manganese steel is poured.

In gears and sprocket wheels the central hole must be bored, the keyway must be cut and the set-screw holes tapped out. Soft steel bushings and inserts provide for these. It is hoped that in the casting process the two steels will more or less fuse together, but they frequently fail to do this. Later, if the gear is severely worked, the soft steel bushing may get loose. The best practice, except for light work, is to have the bore ground to size in the manganese steel. Keyways and set-screw holes must still be cared for as before.

For very large gears a hub and spokes of carbon steel may be used. The ends of the spokes are machined and a manganese steel rim is bolted to them. The first installation is expensive, but renewals are cheaper than if the whole gear were to be replaced.

Screw Conveyor Couplings

Spiral conveyors carrying sand, cement, ashes or similar substances are subject to excessive wear at the coupling bearings in the hangers. Chilled iron couplings running in chilled bushings held in the hangers are much used in an attempt to reduce the wear at this point. Sometimes soft steel couplings fitted with chilled bushings around them, and turning in other bushings in the hanger bearings are preferred, as there is less danger of the conveyor breaking at a coupling. The best arrangement is to use either a solid manganese steel coupling turning in manganese steel bushings held in the hanger, or else to protect the soft steel coupling with a manganese steel bushing, using the same material for the stationary bearings in the hanger.

Track Work

Manganese steel is much used in railroad frogs and crossings to care for the excessive wear. The first application was in the form of inserted plates placed at the points of intersection, but now whole frogs and crossings are cast in one piece. Special work of this sort is of course mostly found in the tracks of standard railroads carrying heavy traffic and in street-car tracks in cities, but it may be found of value in large quarries handling many heavy cars.

Effect of Overheating

It is very important that manganese steel be not subjected to a temperature approaching a red heat. If this is done all the effect of the original heat treatment will be lost, and the metal will become exceedingly brittle. This is the greatest objection to the use of this alloy in elevators handling hot material, though if overheating can be prevented the useful life will far surpass that of any other material.

Rolled and Forged Manganese Steel

The mechanical working of any steel serves to make the metal more dense and uniform and to increase both tensile strength and elastic limit. These properties of manganese steel are almost doubled by hot forging or rolling, and the metal is now available in sheets, rods and special shapes that have been made in this way. These must be heat treated after working just as are castings. Cold rolling by the same methods as those used for soft carbon steel makes a further large addition to the tensile strength of manganese steel, but brings the elastic limit very close to the ultimate breaking point. Such steel will break without appreciable stretch, and can not be bent.

Perhaps the most important use of rolled manganese steel is for screens, especially in handling large tonnages of coarse abrasive material such as trap, granite and crushed slag. Angular flint and chert such as are dredged from many mountain streams come in this class.

These screens are offered in two forms—one made of round rods woven into a coarse mesh of 2 inch to 4 inch opening, and the other of sheets with holes of the desired size punched in them. By properly shaping the rods, the working face of the woven screens can be made practically flat, avoiding the excessive wear that occurs on the humps formed on ordinary screens where the wires cross one another.

Screens made in either way are far superior in length of life to those made of any other steel, but their merits become increasingly apparent as the materials to be handled become harder. Coke is known to be, contrary to what one would expect, one of the most abrasive substances handled in large tonnages. It is said that woven coke screens made of manganese steel will last almost one hundred times as long as those made of ordinary carbon steel.

Rolled sheets are also used as linings for stone and ore chutes and for the launders in which the ore and water mixture flows in western concentration plants. They need not be very thick to have a long life, and this helps to offset their high price per pound. They can not be drilled, and holes that can not be located and punched at the factory are best burned through with the oxy-acetylene torch. Cutting may also be done by this means.

The makers of gas welding apparatus say that manganese steel can be torch-welded, using as a filler a rod of the same material. The writer has not seen this tried, but if the metal can be united it would be necessary to heat the whole piece and quench it in the same way as when it was first made.

It is impossible to cover so broad a subject comprehensively in one paper, but enough has been said to indicate lines along which the use of this unique alloy may prove profitable. The makers are always glad to cooperate in developing new uses for their product, and have accumulated a wealth of information and data that is at the disposal of prospective customers.

TABLE I

Metal	Tensile Strength	Elongation	Merit Number
	Pounds	Per cent	
Manganese steel	140,000	50	7,000,000
Soft steel	60,000	30	1,800,000
Tool steel	130,000	5	650,000
Cast iron	20,000	.5	10,000
Nickel-steel, natural	95,000	21	1,995,000
Nickel steel, heat-treated	207,000	14	2,898,000

TABLE II

S'ple No.	Condition	Tensile Strength	Elongation	Merit Number
		Pounds	Per cent	
1	As forged	88,120	3.5	308,420
	Toughened	145,240	50.0	x7,262,000
2	As forged	81,600	1.56	127,296
	Toughened	150,370	44.44	y6,682,440

x—The toughened steel was 24 times as hard to break as the untoughened.

y—The toughened steel was 50 times as hard to break as the untoughened.

The Barry Sand Company

Michigan's automotive industries has created a heavy demand for core sand, sharp sand and moulding sand. In the early days of the industrial life of the state most of the deposits of this kind were used up but in the Saginaw valley it has been discovered nature left a fine bank of sand which is the equal if not the superior of the old Delray sand now long since vanished.

The deposit worked by the Barry Sand Company in this valley is in the shape of a titanic horse shoe a half mile long, 100 feet wide and from 12 to 20 feet deep. Sand excavated from this horse shoe is combined with sharp sand or lake sand in making cores in the large foundries of the various automobile plants of the state.

The whole operation in the bank is simple and entirely mechanical. A ¾ yard Northwest caterpiller revolving loads directly into cars switched on a spur of the Pere Marquette railroad. As the bank is exceptionally clean and evenly graded by nature screening and washing are not necessary. As each loading area is cleaned out the tracks are moved ahead and there is no difficult handling problem.

Acetic Acid From Lime and Coal

As is well known carbide is made from lime and coal; carbide is used to produce acetylene gas and the latter in turn is converted to acetic acid. The processes for the production of acetic acid from acetylene have been constantly improved in recent years. Acetic acid obtained in this manner is constantly increasing in importance so that its use as edible acetic acid (vinegar) is constantly growing.

The scientific fundamentals of the synthesis of acetic acid are given by G. Reif in the "Zeitschrift für Untersuchung der Nahrungs-und Genussmittel," Oct. 1924 in great detail.

Acetylene, especially under the influence of concentrated sulfuric acid, adds water, as has long been known. The reaction was studied by Berthelot in 1862, who in this manner obtained a substance corresponding to acetylene hydrate or vinyl alcohol. His researches were confirmed by S. Zeisel who obtained crotonaldehyde. Lagermarck and Eltekoff obtained similar results on the conversion to acetaldehyde. Kekulé had observed that crotonaldehyde is extremely unstable and is converted to the so-called solid crotonic acid by the oxygen of the air. The work of Kutscheroff who first used mercury salts as accelerators and arrived at a similar continuous reaction marked an important advance (1884) in the development of this reaction which depends on the hydratation of an unsaturated compound to a saturated compound; he converted allylene to acetone under the influence of mercuric oxide derivatives. Based on this reaction Krüger and Sückert made tests in 1895 on the conversion of acetylene to acetaldehyde in the presence of mercury salts and hydrochloric acid. These data served as a guide to H. Erdmann and Köthner several years later when they attempted to obtain acetaldehyde by passing acetylene into a boiling solution of dilute sulfuric acid in the presence of mercuric oxide. They attempted to determine the conditions which favored the stabilization of the acetaldehyde and diminished the transformation into crotonaldehyde. But their yield of acetaldehyde amounted to only 5 per cent.

Translated from Lechnikes Industrie und Schwergen Chemiker Zeitung by Albert P. Sachs, technical director, Universal Trade Press, exclusively for Pit and Quarry.

The further oxidation of acetaldehyde to acetic acid which is complete in the presence of air and water had long been known. Berthelot had already found that with the aid of strong oxidizing agents, as, for instance, chromic acid, acetic acid was obtained directly. Thus the scientific basis for the conversion of acetylene to acetaldehyde and its subsequent oxidation to acetic acid was known in its broad outlines. The problem was now before industry of making this information useful and to develop it into technological practice. A large series of patents appeared relating to this problem.

Development of the technical synthesis of acetic acid. The first difficulty to overcome was the purification of the acetylene prepared from calcium carbide. The acetylene obtained in this manner contains as impurities varying amounts of ammonia, hydrogen sulfide and phosphide, various sulfurous and phosphorous organic substances (phosphine, mercaptans, carry materials, etc.), the removal of which from the gases was necessary both for technological and hygienic reasons. While ammonia and hydrogen sulfide were easily removed, the elimination of hydrogen phosphide was attended with great difficulties. A large number of reagents were proposed for its removal, all of which depended on an oxidizing effect. Amongst these were chloride of lime, sodium hypochlorite, hypochlorous acid, chlorine, bromine, iodine and chromic acid. As certain inconveniences accompanied the use of these substances, it was attempted to purify the acetylene of its phosphorus compounds by passing acetylene together with oxygen or other oxidizing gas over highly absorbent carbon in which case the conversion to phosphoric acid is very effective if it is carried out in the presence of small amounts of volatile acids, as, for instance, hydrochloric acid. Concentrated acids also serve as purifying media; for instance sulfuric acid and hydrochloric acid to which arsenic acid is added so that the hydrogen phosphide absorbed by the acids formed insoluble compounds with the arsenic and precipitated. Finally the use of mercuric chloride solution was proposed for the purification of acetylene. The early technical difficulties arising in the use of

(Continued on page 104)

Labor and Market Factors in Change From Marble to Lime Production

By George Ransom

DONALD A. SMITH of Ashley, Massachusetts, has a quarry from which marble was formerly taken, but from which he now obtains various forms of crushed stone. He also intends to make lime in the immediate future although he has equipment for this at present.

The property includes twenty-five acres of land of which the existing quarry so far covers only a small portion. The stone extends down to a great depth and in most places is so near to the surface as to require but little stripping. As previously stated, this was originally a marble quarry and the markings of the channeling machines show very plainly, as may be seen from some of the illustrations. Conditions, however, have become unfavorable for this kind of operation, not so much on account of the quality of the stone, but because of labor and market conditions. It is because of this that the change has been made.

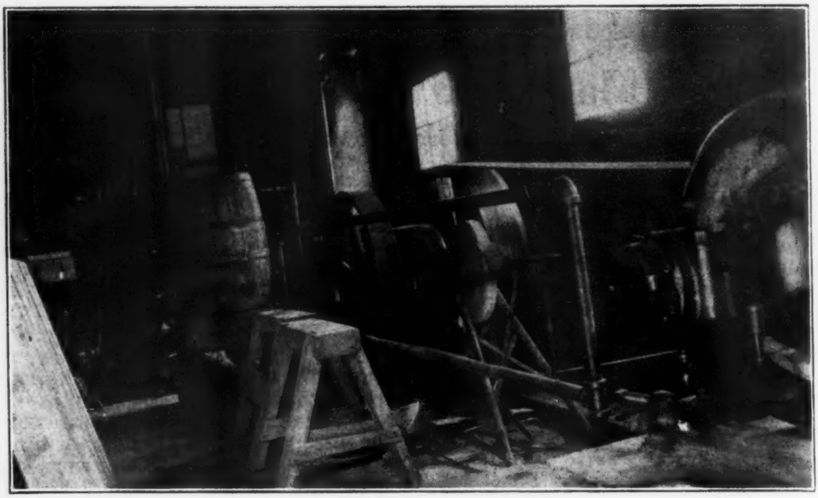
There are two crushing plants. One was installed by the Traylor Engineering Company, but is not now in use. It will be moved at an early date to a more convenient location in connection with the comprehensive changes which Mr. Smith is planning.

The other crushing plant was designed and completely equipped by the Sturtevant Company.

The cars dump into a hopper over a 11x21 Good Roads Machinery Manganese steel jaw crusher which is set to reduce the stone to 2½ inches and finer. The crusher discharges into an inclined elevator which carries the material directly to a number 2 motor driven "open door" Sturtevant rotary crusher set to produce ¼ inch stone. The rotary crusher discharges into a number 3 all steel "open door" elevator which takes the finely crushed stone to a two unit, three deck Sturtevant moto-vibro screen located on top of a bin or hopper. The first screen is clothed to make a ¼ inch and oversize; the second screen is clothed with 10 mesh wire and acts as a scalper for the fine screen which produces an output of 98 per cent through 80 mesh.

The oversize from the first screen passed by gravity back to the rotary crusher for further reduction. The intermediate product falls into a bin from which it is either discharged directly into a car as shown in the illustrations or can be drawn off through

Working Face of Quarry Showing Tracks

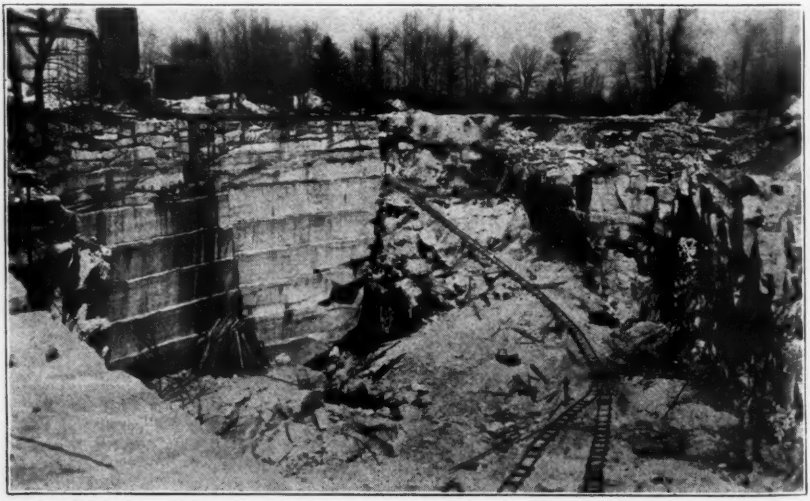


Motor Driven Compressor

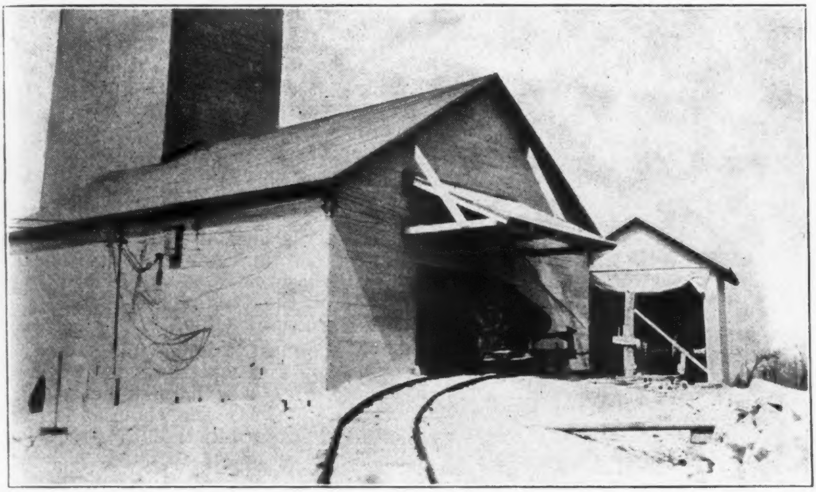
a spout into trucks or bagged as desired.

The fines pass from the screen discharge into a hopper from which they are bagged. This plant is capable of producing 11 tons or more of 2¼ inch and finer stone per hour, but is limited to the capacity of the quarry. A 25 h.p. motor drives the jaw crusher and both elevators, another 25 h.p. motor drives the rotary fine crusher, and a 2 h.p. motor operates the moto-vibro screen. Leather belts were originally installed for the motor drives, but on account of the dust, etc. they were unsatisfactory. Since then rubber fabric belts, made by the Boston Woven Hose and Rubber Company and known as Perfection, Y top, have been used with complete success. Crescent belt clips are used to join the ends. The products turned out are stucco dash, granite or terrazzo, marble chips, concrete aggregate and agricultural lime.

The stone for the crushing plant is broken to the proper size in the quarry by hand. The drilling is done by means of Ingersoll-Rand jackhammers. The stone is also loaded by



Kilns Will Be Located at Right of This Picture



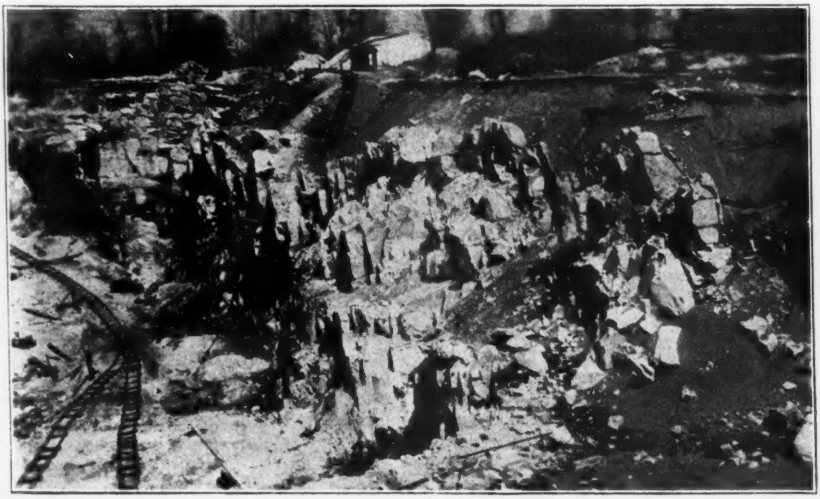
Hoist For Pulling Dump Cars to Crusher

hand into the Easton cars and pulled up the incline by an American Hoist and Derrick Company's hoist, driven by a twenty horse power direct connected General Electric induction motor and Roebling cable.

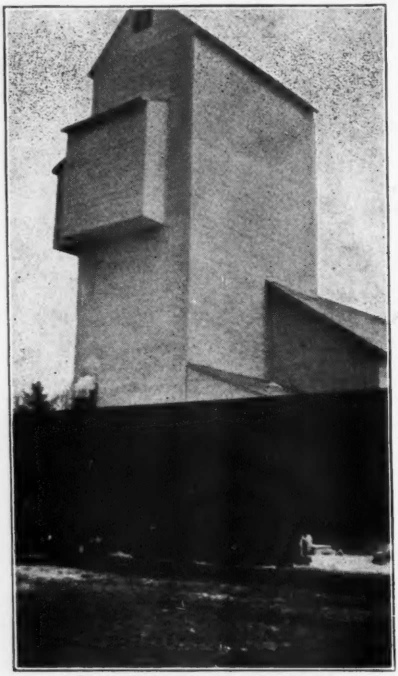
Air for the drills is supplied by a 9x8 Ingersoll-Rand compressor. This is located in a small building by itself which also serves as an office. The motive power is a twenty-five horse power Wagner motor and a Sagamore rubber fabric belt.

Although the plant is at present not a large one, everything about it is strictly modern and efficient. Mr. Smith believes in saving labor. Thus, in addition to the machinery already described and in line with his ideas, there is a Fordson tractor equipped with grid wheels and a Burd tractor hitch. This is for moving freight cars on the spur and it is capable of hauling two or three at a time.

Although the crushed stone in its various forms will always be an important item in the busiiness, the deposit here is extremely valuable for making lime. It is really too good to be used for anything else. The stone



Breast of Quarry Opposite Kilns



Outside of Crushing Plant

is a true dolomite and very pure. There are almost no veins of inferior material so that there is practically no waste. In fact, if the question of size could be controlled by blasting, it could be loaded by a power shovel so far as the need of sorting is concerned.

The quarry is located almost directly adjacent to the main line of the Berkshire Division of the New Haven Railroad and, as will be seen from one of the illustrations, the terrain is such that the kilns may be located close to the edge with the railroad spur close to them. It is Mr. Smith's intention to erect two kilns as a beginning probably during the coming summer and more later on.

With the kilns so close to the quarry, it will be possible to charge them directly by means of an incline or derricks with a minimum of haulage. Either of these methods will remain possible even after the quarry has been worked for a long time, in the first place because it is possible to go very deep and in the second place because the broad working face will be opposite the kilns. With these conditions very economical operation should be possible.

F. A. Jones Resigns

F. A. Jones, manager of the Columbia division of the Pittsburgh Plate Glass Company at Zanesville, Ohio, has resigned, effective, June 1. Mr. Jones is the father of the Columbia cement idea. Shortly after he came to the Pittsburgh Plate Glass Company from the Kelley Island Lime and Transport Company in 1919, he conceived the idea of utilizing screenings from the limestone quarry operated by the company to supply raw material for the Columbia Chemical plant at Barberton, Ohio.

Mr. Jones designed and erected the crushing and screening plant and was proud of his accomplishment, but he could not bear the thought of from three to four hundred tons of screenings going to waste daily. He analysed the shale in the neighborhood and found that it was of an excellent quality for making cement and put up to the company the proposition of erecting a 2,500 barrel cement plant to absorb this waste.

At first the company did not think well of the proposition and Mr. Jones set to work to organize a separate company to erect the plant and purchase the screenings from the company. Finally, however, the Pittsburgh Plate Glass Company decided to build the plant themselves and appropriated $2,000,000 for the project.

The plant was put in operation in June, 1924, manufacturing a high grade of portland cement and it was fully described in the May, 1924, issue of Pit and Quarry. Its reception was so good that a little more than a year later the company ordered the capacity of the plant doubled. Work was started immediately and the project is now more than half completed. It is expected the work will be completed this fall.

Mr. R. J. Rudd, sales engineer, has taken charge of the Columbus, Ohio, office of the Lidgerwood Manufacturing Company. He is located in the Atlas Building. Mr. Rudd has had long experience in the sale of material handling equipment, hoists, derricks, etc. He has a wide knowledge of the operator's work and requirements, and is thoroughly well equipped for handling his present line.

New York Artificial Stone Co., Inc., (deal in building materials). Capital $500,000.

Asbestos Insulating Materials

By W. Hacker in "Kunststoffe"*

IN preparing insulating materials of wide applicability asbestos occupies a unique position as a basis material. Its application for this purpose is very easy, and this justifies the favor shown this material although its heat insulating capacity is not remarkably great. If the heat insulating capacity of hair felt is put as 100, the following insulating materials have these values:

Slag-wool No. 2	83.0
Sawdust	68.0
Slag-wool No. 1	67.6
Charcoal	63.2
Pine shavings	55.3
Clay	55.1
Asbestos	36.3
Air	13.6

Although the heat insulation value of asbestos by itself is not particularly large, this condition is quickly changed if asbestos is used in combination with other suitable insulating materials. Thus, for instance, the so-called "Patentgur" an insulating material made up of blast furnace slag and asbestos fibers is extremely effective (80.1 per cent insulation value). It approaches the best known heat insulating material for steam lines which is glass wool in a special composition with Kieselguhr cords (90.6 per cent insulation value). The number of asbestos compositions is extremely large, but the best asbestos compositions for heat insulation purposes contain 15 to 25 per cent long fiber asbestos, 70 to 80 per cent Kieselguhr of specific gravity up to 0.25 and 5 to 10 per cent of glue or other binding material, while ordinary asbestos sheets consist of 80 to 85 per cent asbestos, 15 per cent Kaolin, 3 per cent Kollodir, the necessary coloring materials (red lead or granite) and the materials added to increase the resistance to water (ammonium alum, aluminum sulfate, oil or soap). Kollodin is obtained by the solution or rather formation of a paste of 25 parts of potato flour, 2 parts caustic lye and 50 parts of water.

To prepare a calking material for steam lines, a mixture is made up of 40 per cent asbestos and 20 per cent each of slag wool, paper pulp and hemp yarns; the mixture is worked up in a hollander, the mass is spread out in sheets and saturated with water-glass and then air-dried. Heat insulating materials are also prepared by impregnating asbestos and gypsum with molten sulfur and hydrocarbons. In addition the molded mass is saturated with a mixture of pitch and rubber. Resistant insulating materials are obtained also by impregnating asbestos masses with melted rosin in vacuum. According to an American patent to prepare a heat insulating medium a mixture of asbestos, cement and a fusible hydrocarbon mixed together hot are dipped into a heated liquid hydrocarbon at such a temperature that the hydrocarbon originally added solid melts within the mass. A French patent describes an insulating material obtained by heating a mixture of tar and asbestos at 250 degrees. The product is pulverized and it is again heated to a high temperature and then molded. A British patent describes the preparation of an insulating material from asbestos and tar which has been dehydrated and freed from light oils. According to another British patent an insulating material for boilers is obtained from a mixture of sodium silicate, asbestos, vegetable or animal oils, alkali carbonates and water. A plastic insulating mass not shrinking even at high temperatures is prepared by mixing 80 parts of long fiber asbestos, 10 parts of powdered talc, and 20 parts of finest graphite flakes with 40 parts of an oil mixture of the highest ignition point. This plastic mass is treated with 150 parts of composition metal in the form of drops and a viscous, adhesive fatty mixture which coats the metal drops, and the whole is ground to a homogeneous mass. The heat insulator "Isol" is composed of 10 per cent of a red oxide of iron, 10 per cent calcium carbonate, 64 per cent quartz sand and asbestos and 13 per cent water with about 3 per cent molasses as binder.

An insulating material for electrotechnical purposes is obtained by pressing and drying a mixture of asbestos, pitch, asphalt and easily flowing organic liquids. Sulfur alone or in solution, or oils or resinous binders capable of absorbing oxygen from the

*Translated by A. P. Sachs, Technical Director, Universal Trade Press Syndicate, exclusively for Pit and Quarry.

air are added to accelerate the hardening of the mass. A plastic material suitable for use as an electrical insulator is obtained according to a British patent by molding a heated mixture of 1 part mineral rubber, 28 parts mica flour, 100 parts of asbestos or serpentine flour, 9 parts sulfur and 40 parts shellac under pressure.

Artificial masses containing chiefly inorganic materials such as asbestos, silicates, etc., are colored with coal tar dyes as follows: The mass is placed for about half an hour in boiling hot solutions of diamine dyestuffs containing 4 to 10 grams of dye, 1 gram soda ash and 1 gram glaubers salt per liter. The following dyestuffs may be used: diamine fast blue FFB and FFG, diamine mineral blue CVB, diamine fast red F, diamine red 4B, diamine fast brown G, fast yellow B, fast orange B, green B and G, fast black, concentrated.

In this connection, a few words on the purification of asbestos should prove of interest. The purification can be carried out so as to remove magnesite the principal impurity of the raw material by heating in hydrogen at 400 degrees C. for 20 to 24 hours, then treating with dilute acid to dissolve out the reduced compounds; the pure asbestos is then washed and dried. According to a British patent the crude material is saturated with oil and then placed in water to which some gasoline has been added; the impurities settle to the bottom while the asbestos floats on the surface.

Research in Georgia Clay

Georgia clays, properly mined, refined and blended, can be utilized in the manufacture of chinaware, tiling, high-grade refractories, and ornamental face brick, and can be used to displace to some extent imported clays, according to the Bureau of Mines, Department of Commerce, which has finished a technical study of these clays, in cooperation with the Central of Georgia Railway. The State of Georgia contains large areas of sedimentary kaolins and bauxites of industrial importance. Considerable development has taken place, and many undeveloped deposits are available. Many of the clays burn to a good white, while others burn to a cream color. Georgia clays have been used extensively in the sanitary tile and electrical porcelain industries, but some manufacturers of these wares have not made use of them because black specks developed during the firing.

The Bureau of Mines investigators found that, by the use of proper washing methods, the Georgia clays can be washed free from material that causes dark specks in whiteware. It was found that many clays which burned to an undesirable cream color could be produced white enough to meet requirements if the proper care were taken in their mining and refining. A serious problem in connection with the use of sedimentary clays in white ware is the high bisque loss and excessive shrinkage. These difficulties can, the bureau found, be largely overcome by proper body mixes and by the blending of the clays.

Georgia contains large deposits of refractory clays suitable for the manufacture of high-grade refractories. If enough of the clay is fired to a high temperature and used as a grog, the brick will go through the process of manufacture readily and will withstand every laboratory test for a high-grade refractory. Furnace tests under actual working conditions have proved that the service rendered by fire brick made from Georgia sedimentary kaolins was at least equal to and in most tests superior to that rendered by fire clay and aluminous brick.

These findings are of real industrial importance in view of the fact that supplies of the best fire clays of Pennsylvania, Maryland, Ohio and Kentucky within reach of the railroads are decreasing, and the average quality of the fire-clay refractories classed as No. 1 has fallen off within the last 15 to 20 years.

Light-cream and light-gray face brick can be made from a mixture of Georgia kaolin, aplite, and sand, and these brick compare favorably with the best face brick from the fire clays of the Freeport, Mercer, and Kittanning formations of Pennsylvania. Details of this investigation are contained in Bureau of Mines Bulletin 252, "Beneficiation and Utilization of Georgia Clays," by R. T. Stull and G. A. Bole.

The Sherman Cement Company, New Britain, Conn. Capital $5,000. Officers, Howard T. Sherman, Robert H. Sherman, Henry C. Rowe and Robert J. Kleinberg.

Fibro-Cements

By E. Flajard in "Le Ciment"

FIBRO-CEMENT is fundamentally a mortar of asbestos and cement, the use of which dates back to 1882. It has given rise since that date to a great number of inventions relating both to the composition of the product and to the method of manufacture.

At first the chief purpose of fibro-cement was to produce a non-inflammable material. At present the chief endeavor is in the manufacture of thin sheets or of artificial shingles or to form roofing or partitioning at once light and easy to transport. They are chiefly commercial specialties such as Légerite, Isodrite, Everite, Eternit.

The manufacture of firbo-cement varies with the brand; in a general way it consists of the following stages:

1st Preparation of the mixture of cement and crushed asbestos;

2nd Conversion of the paste into sheet form;

3rd Compressing of the sheets;

4th Hardening and drying;
5th Fabrication (cutting, etc.);
6th Recovery of by-products.

Preparation of the Mixture. It consists principally in crushing the crude asbestos so as to open up the fibers. The asbestos is then swelled by a strong humidification, and mixed with the dry cement. There are several types of crushing machines; they present no unusual features.

The usual mixture ratio is 6 of cement to 1 of asbestos.

Fabrication of the Sheets. In a general way this fabrication is similar to that of paper (or rather to that of cardboard, considering the thickness of the product). The mixture is placed in agitator pans and fed by a continuous device to a machine consisting of an endless belt guided by cylinders. The mixture drops onto the belt across a screen, is distributed there by a stream of water in such a manner as to form a pasty sheet which is drawn off by a large cylinder. There it is thickened and it emerges as a large sheet which is cut into pieces of the desired dimensions by special cutting knives. The sheets are piled up on a truck, being separated from each other by smooth, oiled steel plates. The size of the original sheets is of the order of 4x8 feet.

Compression. This is carried out by hydraulic presses on the whole truckload at once. The pressure is very high, reaching 800 atmospheres. Its chief object is to remove most of the water which drops from 36 per cent to 10 per cent which the thickness is reduced from 0.20 inch to 0.16 inch. Care must be taken that this operation is completed before the cement sets which would result in the production of a more or less disintegrated product. To produce large panels for partitions with a surface of 1 to 2 square yards it is not necessary to perform this compression.

Hardening or Drying. This operation is carried out in a setting chamber. At the end of 24 hours hardening has progressed sufficiently so that the oiled steel plates can be removed; the cement sheets are then aged in a store-house where they dry in piles for two months.

Fabrication. The sheets of fibro-cement intended for tiles or panels are cut with holes so that the necessary studs or nails can be used. This work requires no special equipment.

Recovery of By-Products. This relates particularly to the materials carried off by the water in the production machine. By means of a filtering and clarifying arrangement a mud is obtained which is mixed with the original asbestos.

Fibro-cement is a sort of reinforced cement, the elastic asbestos fibers playing the same part as the steel in ordinary ferro-concrete. It has been attempted to replace the asbestos by other materials with similar properties; vegetable fibers such as jute, wood fibre (especially aspen), etc. However the characteristic properties of incombustibility are lost, but the elasticity is retained. In another group of products it has been attempted to use sheets of mica or even of glass wool. The great difficulty is to obtain a sufficient adhesion between the cement and the reinforcement. For this purpose numerous proposals have been made to incorporate in the mass of the two principle ingredients a filler such as glue, bitumen, pulverized stone, etc.

Besides, as has been said each commercial variety is based on treasured secret formulae and processes of manufacture. In addition to its properties of elasticity fibro-cement possesses a long life because of its resistance to climatic changes, to fire and to frost. It is also very impermeable which renders it so valuable in roofing work.

Tiles of fibro-cement have over other materials like wood, slate, ordinary tile, asphalt, etc., the advantage of rigidity, and joints with a high resistance to bending; they do not break nor warp. They can be colored in the manufacturing process so that a more or less esthetic use can be made of them.

It is easy to lay them, thanks to the perforations which permits laying them on a wooden frame with nails or with copper fasteners. Generally they are fastened to a light continuous scantling.

The large sheets of fibro-cement are used either for covering to replace tiles which causes quite an economy but at the expense of beauty or to make ceilings, or even to cover interior walls or for partitions.

In the last case on account of the thinness of the sheets there is little resistance to sound so that it is better to use a double wall. It is possible to buy ready made sheets based on this principle but in which the filler is a more or less inferior chalk. This last use has not been sufficiently developed for in spite of everything the cost is higher than for ordinary partitions. But it seems to solve the problem of portable partitions which has already been solved in so many ways with respect to the outer walls. Let it be added finally that fibrocement can be used for the manufacture of furniture and in both exterior and interior decoration in the form of panels which can be glazed smooth or painted.

N. J. Darling, of the General Electric Company, is responsible for the declaration that management is charged with providing a safe and sanitary working place; safe machinery; safe processes; responsible supervisors; careful check of employees' physical fitness for jobs; eternal vigilance on the part of all. Success in reducing lost-time accidents will be found in eliminating the causes of such mishaps.

Brown Pyrometers

One of the most attractive catalogs published in recent weeks has just been issued by the manufacturers of Brown pyrometers. It is excellantly printed and bound and has a wealth of illustrations many of them in five colors. Operators of lime and cement plants will be interested in the many improvements and changes of design in the new instruments.

The manufacturer states that the new designs incorporate eight new features of vital importance. One page of the catalog is devoted to a reproduction of a certificate from the United States Bureau of Standards showing an accuracy for the pyrometers of 1/3 of 1 per cent of the full scale in spite of a change in atmospheric temperatures from 76 to 117 degrees Farenheit.

The description of the various types of Brown pyrometers, indicating, recording and signaling are thoroughly gone into. The multiple continuous recording instrument contains a number of interesting features. The chart is mounted with driving rolls and platen so that notes can be made in ink or pencil on the chart. The ribbon is automatically moved back after each impression so that the record is visable immediately. Every part of the instrument is easily accessible and the chart can be changed readily. The instrument automatically compensates for cold junction and indiates the correct starting point on the open circuit. In the multiple recorder a dial numbered and colored to correspond with the record lines on the chart indicated the couple making the record. A switch alternately connects the couples to the galvanometer.

The manufacturers are proud of their new moisture proof rotary switch which has an individual return system of wiring with contacts and binding posts inclosed in a water and dust tight housing. All wiring connects to the binding posts without soldering and enters and leaves the switch either through conduits or stuffing tubes.

Sillimanite protecting tubes are now used for platinum thermocouples. This tube withstands the highest temperatures, hard knocks and sudden thermal changes. While these tubes were originally designed for high temperature work their qualities make them desirable for low temperature work as well.

Experiments in Flotation of Limestone From Siliceous Gangue

By Oscar Lee

Associate Metallurgist, Bureau of Mines, Department of Commerce

FLOTATION is generally regarded as a process that is only applicable to metallic minerals. However, its scope is now known to be greater than this, because some of the nonmetallic minerals are floatable, such as graphite, sulphur, and fluorite. Recent observations show that limestone may be added to the list of floatable nonmetallic minerals. Such work is being done on a laboratory scale at the Southern Experiment Station (Tuscaloosa, Alabama) of the Bureau of Mines, Department of Commerce, where experimental magnetic concentration of the low-grade iron ores of the Birmingham district is in progress. Certain experiments have demonstrated that the limestone may be floated from the magnetic log-washer tailing, and then incorporated in the iron concentrate.

If the loss of lime could be prevented, some ores though low in iron and high in insoluble contain enough lime to make their concentrates self-fluxing. Since this loss in the magnetic log-washer can not be avoided, the lime must be recovered from the tailing by some method and added to the magnetic iron concentrate before sintering. Then the resulting concentrate will be self-fluxing.

While seeking a suitable means of treating the tailing for recovery of lime, flotation was tried. It was at once evident that this method had possibilities. During the early part of the investigation, soap solution made from a common soap was used as a flotation reagent. The froth obtained was a fairly good lime concentrate. This result was an important clue, and led to tests with the use of such reagents as oleic acid and sodium oleate. Later, cresol, creosote, coal tar and other similar flotation reagents were tested in combination with the oleic acid and soap solutions. As a result, oleic acid and cresol used together were found to be satisfactory.

The tailing from the magnetic log-washer is in excellent physical condition for flotation. The iron ore had been ground in a ball mill to 100 mesh for magnetic concentration. Hence the bond between the lime carbonate and the other constituents of the tailing was well broken.

Fair results may be obtained by flotation in one stage. However, the work is more efficient when the roughing-and-cleaning system is followed; the tailing from the cleaner is returned to the rougher.

The results of two typical tests presented in Table 1, will suffice to show how freely the lime floats in the presence of the siliceous gangue. The respective tailings from two ores were used. One had a tenor of 24.6 per cent CaO, and the other, 33.4 per cent. The tests were made under similar conditions in which the reagents were the same and the roughing-and-cleaning system was used. The only difference in the two tests was in the amount of reagents used.

Although Sample A was relatively lean, it yielded a concentrate as rich in lime as Sample B. Probably the recovery will be lower when a tailing of low lime content is treated. The concentrate from Sample A, as well as that from B, compares favorably with the limestones utilized at present as flux. The average analysis of the limestone now used in the Birmingham district is as follows: In-

TABLE 1—FLOTATION OF LIMESTONE FROM SILICEOUS GANGUE

Product	% Weight	Assay Per Cent: Lime	Insoluble	Iron	% of the lime recovered	% of the insoluble rejected
Sample "A"						
Feed	100.0	24.6	40.4	8.2	....	....
Concentrate	39.3	49.8	2.4	2.6	79.5	....
Tailing	60.7	8.3	65.0	11.8	....	97.7
Sample "B"						
Feed	100.0	33.4	24.5	5.6	....	....
Concentrate	59.4	48.7	3.2	4.0	86.5	....
Tailing	40.6	11.1	55.7	8.7	....	92.3

TABLE 2—RESULT OF ADDING FLOATED LIME TO IRON CONCENTRATE

Product	Assay, Per Cent			% of the iron recovered	% of the lime recovered	% of the insoluble rejected
	Iron	Insoluble	Lime			
Ore	35.3	23.2	11.9	....	....	....
Iron concentrate	51.4	12.6	4.3	95.84	....	....
Tailing to flotation	4.3	42.3	25.4	....	....	62.7
Flotation concentrate	3.0	3.0	48.5	....	....	....
Final sintered concentrate	50.3	12.9	13.3	97.1	76.1	....

soluble 3.5 per cent, iron 0.5 per cent and lime 53 per cent. Dolomite is used extensively as a flux and averages 1.5 per cent insoluble, 0.5 per cent iron, 30.3 per cent lime and 20.7 per cent MgO. The lime concentrate is somewhat higher in iron than the commercial stone, but the purpose of smelting is to recover iron. Hence this is not an undesirable feature.

In order that flotation may be successfully applied to the iron ores containing a comparatively small amount of lime, a high recovery of lime will frequently be necessary. Consequently an effort is being made to increase the percentage of lime floated.

Inexpensive reagents are used, hence the quantity necessary for a good separation would not be prohibitive. The amount required as indicated by the tests would not exceed 1.5 pounds per ton of tailing treated. About equal quantities of oleic acid and cresol appear to give the most satisfactory results. At prevailing prices these two reagents cost 1 cent and 18 cents per pound, respectively.

In order to give a clear idea of the effect of adding the floated lime to the magnetic concentrate, a few figures are presented in the table below. A typical ore was selected for the illustration.

The value of lime flotation is manifest in the above table. Not only is use made of the available lime for fluxing the gangue, but also the recovery of iron is increased and the sintered concentrate is rendered self-fluxing. Such a product would reduce very rapidly in a blast furnace, and thereby cause a pronounced increase in furnace capacity.

Security Sand & Gravel Co., 11 W. Washington St., Chicago, Ill. Capital $175,000. Operate sand and gravel pits. Incorporators: Glen A. Lloyd, Anderson A. Owen and Frederick C. E. Lundgren. Correspondent, Fisher, Boyden, Kales & Bell, 134 S. La Salle St.

Eliminates Strain on Crane

Fred J. Schmidt of Bedford, Ohio, operates a fleet of Autocar trucks to get his sand to the building trade and concrete products manufacturers of Cleveland and its environs. Early in his operation Mr. Schmidt found it impossible for trucks to pull out of his pit in high gear and therefore had his bins set from 15 to 25 feet below his crane track level. Instead of elevating sand to a high level by means of his locomotive crane he has the trucks pull the sand up a gradual incline.

This cuts down the wire rope replacement on the crane and saves considerable in fuel and wear and tear on the machine. Mr. Schmidt took over the plant in 1924. It had been previously used for loading cars but he installed three 60 ton Butler bins and began serving the local trade. Over two of the bins he installed Hummer screens and on the third a gravity screen to separate the concrete sand. For this material it is necessary to screen out only the 1 inch oversize. The deposit contains only 5 per cent loam and this method is very economical and efficient.

The Hummer screens are used to separate the mason's sand and the plaster and finishing sand. The screen for the former is mounted on a steel bin with a feed hopper. The plaster sand is fed to the screen by a 100 foot span belt conveyor.

An Ohio locomotive crane is used for excavating. Mr. Schmidt is in the builder's supply business as well and this crane also comes in handy for unloading from cars crushed stone, cinders, slag, etc., and for reloading them on trucks. It is also used for spotting cars.

Mr. Schmidt produces five grades of material, mason's plaster, concrete and finishing sand and conglomerate, which contains about 60 per cent gravel and 40 per cent sand.

The Ainslies Lime Rock Co., Macon, Ga. Capital $500,000.

New Modern Silica Sand Operation Opens Up in Wisconsin

THE Westfield Silica Company, a Wisconsin corporation capitalized at $100,000 under date of February 18, 1926, has developed a white silica sandstone deposit five miles north of Westfield, Wisconsin, Marquette County, to produce and market a clean, dry white silica sand, both screened and powdered grades.

The land, which is held in fee by the company, comprises about 35 acres and the sandstone deposit rises to an elevation of approximately 85 feet and to considerable depth. Laboratory tests show the material to average 99 per cent silica and impurities exceedingly low, while the sand grains are sharp and well defined the fusion point is 3128 degrees F.

The quarry and plant are located just to the right of Wisconsin Highway number 10 and the company has constructed about 4000 feet of switch track connecting with the Soo Line. The track as now installed at the plant provides for 10 empty car storage but this can be increased at any time without disturbing the present plant layout.

The crushers, conveyors, elevator and screening equipments are electrically operated, belt drive, with a total of 157½ h. p. The electric power is purchased from the Wisconsin Power and Light Company. The air compressor for operating the pneumatic drills and triple drum derrick engine is supplied with power from auxiliary steam boiler plant having 100 h. p. capacity; this steam plant also supplies necessary pressure of steam through a system of steam coils in the drier bin. The water is obtained from a 60 foot well on the premises and is delivered to storage tank by gasoline driven pump.

Ingersoll-Rand pneumatic jack hammers are used for drilling and the holes are staggered about 5 feet apart and drilled to a depth of from 6 to 10 feet. Forty per cent dynamite is used for blasting. The sand stone is comparatively soft, blasts to reasonable size lumps and is reduced to sand very easily.

The blasted sand stone is loaded by hand labor into strongly constructed combination steel and wood skips, each of four thousand pounds capacity. These skips are equipped with hoist chains and quick release lock. The quarry foreman allocates these skips for convenient loading in the quarry, this being performed by 10 ton capacity wooden derrick with 62 foot boom and 72 foot mast operated by triple drum steam hoist engine. The skips, when loaded, are picked up by the derrick and swung to a number 7½ Telsmith gyratory crusher. The material from this crusher is carried on a 24-inch troughed conveyor belt to a 4x12 foot gear drive rotary screen which passes material up to one inch. The material passing through this first rotary screen is dropped into a shoot and carried by gravity to a boot where it is picked up by a 24 inch by 15 foot bucket elevator and taken to the second 4x12 foot rotary screen which is directly over the drier bin. This rotary screen is lined on the outside with number 20 mesh Tyler screen cloth.

The material remaining on the first rotary screen is dumped by gravity into the number 5 Telsmith gyratory crusher, from which it is gravitated to the same boot as material passing through the first rotary screen and likewise carried to the second rotary screen by the short bucket elevator referred to.

The material held on the second rotary screen is carried by Stephens-Adamson 16-inch by 16 foot troughed belt conveyor to a set of United Iron Works rolls and from these rolls it is gravitated to the same boot as material passing through the first rotary screen and number 5 gyratory crusher and again carried by the short bucket elevator to the second rotary screen.

The sand passing through the 20 mesh on the second rotary screen is distributed over the steam coils in the drier bin. This bin is built "V" shaped and the steam coils are installed horizontally to the contour of this bin. The bottom opening of this sand drier bin is equipped with hand operated steel slides so as to regulate the flow of sand to the Stephens-Adamson 24 inch by 30 foot troughed belt conveyor, which is located directly under the sand drier bin. This conveyor carries the dried sand from the drier bin to a boot which is located about 7 feet beneath the ground level where it is picked up by a Stephens-Adamson 16 inch by 58 foot vertical bucket elevator operating at a speed of 250 r. p. m. This elevator delivers the dried sand to a steel feed box fitted with adjustable flop gate and carried by gravity to two 12 inch by 26 foot screw conveyors made up of ¼-inch steel flights mounted on 3-inch standard pipe. Each of these screw conveyors is enclosed in rectangular steel boxes and each of these boxes have twenty-four 1-inch in diameter discharge holes, fitted with slide plates for regulating flow to Tyler "Hummer" vibratory screens. The over-flow of sand through the screw conveyors is carried by gravity to the sand drier bin.

The plant is equipped with five 6 foot type 37 "Hummer" vibratory screens, two surface, open bottom type with angle changing device. The sand from the "Hummer" screens is gravitated to proper bins arranged for coarse, medium and fines. Each storage bin is equipped with flexible steel shoots for loading into box cars by gravity. Arrangements are in contemplation for bagging sand at the plant, erection of additional storage bins and installation of grinding equipment.

The plant has a crushing capacity of from 150 to 200 tons per hour, while the drying and screening equipment as now installed has a capacity of 50 tons per hour.

Operation of the quarry and plant is under the supervision of V. E. Mitchell, and F. C. Evans is in charge of sales; the general sales office being located at 37 W. Van Buren Street, Chicago. The officers of the Westfield Silica Company are as follows: A. R. Young, Kansas City, Missouri, President; V. E. Mitchell, Westfield, Wisconsin, Vice President; C. G. O'Neil, Chicago, Treasurer and F. C. Evans, Chicago, Secretary.

Winchester & Muhlberg, Inc., Jersey City, N. J., (deal in building materials, etc.); $25,000 preferred and 500 shares common stock, no par value. Incorporators: Louis Winchester, Julius Muhlberg, Adolph Klingenstein, Jersey City. (Atty. Alfred E. Almsler, New York City.)

The Mission Chalk Rock and Products Co., Carmel, Calif. Capital $5,000. Officers: William Machado, L. W. Jordan and C. W. Bates.

(Continued from page 92)

this salt due to the gradual diminution of its activity was overcome by treating the purification liquid with chlorine and with a salt, especially ferric chloride which prevented the bothersome foaming.

The technical preparation of acetic acid from acetylene is carried out today in a single process without the actual isolation of acetaldehyde. The pioneer successes in the field of the technical preparation of acetaldehyde and acetic acid from acetylene were due to G. Reif, N. Gruenstein and the Konsortium für elektrochemische Industrie, G. m. b. H. of Nürnberg (now of München). A large number of chemical factories followed them.

The first patent for the preparation of acetaldehyde from acetylene was obtained by Gruenstein in 1910. He attempted to render the results of Erdmann and Köthner technically usable. But this proceeded only slowly. And at first there were considerable difficulties in the commercial conversion of acetaldehyde to acetic acid.

Gradually there was a transition to the process of the direct conversion of acetylene to acetic acid so that the expensive intermediate isolation of acetaldehyde was avoided. Early success was obtained with this when acetylene was treated with solutions of hydrogen peroxide, persulfuric acid or sulfomonoper acid or their salts or the compounds obtained acidifying peroxide-producing salts such as perborates, percarbonates, and superoxides in the presence of mercury or mercuric salts. The conversion of acetylene to acetic acid in a single stage was carried out chiefly, however, by the following process; acetylene and oxygen were passed alternately into acetic acid which contained at least the theorectically necessary amount of water, in the presence of mercury derivatives such as mercuric oxide, mercuric sulfate, or mercuric phospate with or without the addition of other catalysts such as phosphoric acid, sulfuric acid, bisulfate, etc. In this way a concentrated acetic acid was obtained directly whih could be purified by distillation or by other methods. In place of acetic acid as the initial liquid other suitable organic acids such as chloracetic acid and lactic acid could be used. It also proved advisable to add to the mercury compounds other contact substances which yielded oxygen easily such as ferric oxide, vanadium pentoxide, manganese oxides, etc.

Mundy Three-Speed Transmission Hoist

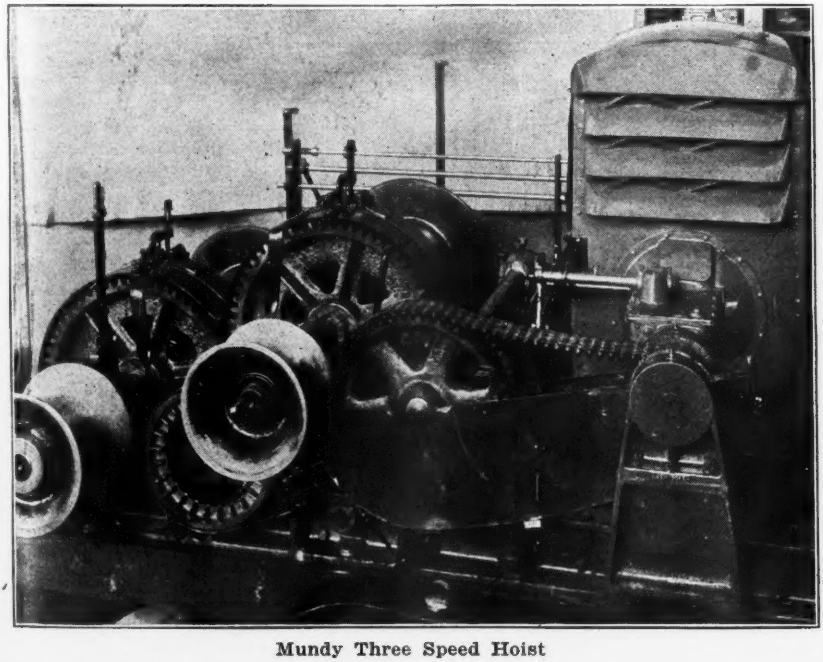
Probably the most radical development in hoisting equipment since the introduction of the cone friction by the J. S. Mundy Hoisting Engine Company, patentee, which was introduced back in the 80's, is the new three speed transmission, similar to that used in heavy motor truck service, applied to the gasoline hoist. This application has just been patented in the United States and Canada for gasoline and electric hoists. This development has been brought about by the feeling that considerably more could be accomplished if one hoist could be purchased for two or more varied loads, at more economical speeds.

In lighterage work, steel erection, quarrying and in excavation, also in general construction work, this machine has a definite place. On these classes of installations, hoists are at various times handling different loads. Therefore, with the three speed transmission the operator can shift in less than ten seconds to a higher or lower line pull, as his condition warrants.

The contractor, for instance, can use this hoist on a concrete tower in one speed and can handle a brick elevator raising barrows of brick and mortar at a higher speed. Instead of purchasing two hoists, one a high speed hoist for light hoisting and one a slow speed for heavy hoisting, one machine will now do the work. On a construction job it is oftentimes required to lift very heavy loads, and then turn around and lift light loads. With the new Mundy three speed hoist, in the 60 h.p. size, the operator has at his immediate command an average line pull of approximately 9000 pounds in slow speed, 6000 pounds in intermediate speed, and 4500 pounds in high speed, with line speeds inversely proportional to the line pulls. When operating a derrick this will frequently eliminate the necessity of reaving with more parts of line on heavy loads as has been the case in the past.

The transmission used, as mentioned above, is similar to that of the best grade of motor trucks, and the ease with which the operator shifts from one speed to another is accomplished just as readily as it is on the motor truck.

The lateral thrust on the transmis-



Mundy Three Speed Hoist

sion box is taken care of through ball bearings on each side of the silent chain drive, which runs in an oil tight casing.

A hoist with this transmission when comparing it with present day machines, will save considerable time in hoisting on various classes of work.

The attention required on this machine is practically no more than that which is needed on a gasoline hoist without the gear box, of course, with the exception that it is necessary to put in fresh grease in the transmission about once a month.

This new development is obviously a mile stone in the hoisting equipment industry and gives a flexibility in hoisting equipment never obtained in the past.

New High Capacity Truck Loader

The George Haiss Manufacturing Company have lately brought out a new high capacity truck loader which has a loading capacity of 4 yeards per minute.

This machine is equipped with caterpillar traction, has four strands of chain and two strands of buckets, making a total width of bucket 37 inches. The loader is equipped with a 37 h.p. Waukesha engine and a transmission box which encloses the clutches and gears, similar to that used on their path digging loaders. The tail shaft is 9 feet long, which means that the loader clears a path that wide, so that it can be crowded into the pile with the slow speed mechanism at 30 inches per minute. The elevator unit is pivoted on an "A" frame and is equipped with a raising and lowering device actuated by a hand wheel through a worm and gear jack knife.

This device makes it very easy for one man to raise and lower the elevator as necessary. Like all Haiss loaders, this machine is strictly a one man operated machine. All the sprockets as well as the chain are manganese, making for extra long wear. The loader has a clearance under the spout of 10 feet. One of these machines has recently been purchased by the Stephens Fuel Company of New York City who are loading material at the rate of 4 yards per minute.

Gunton Park Collieries, Inc., Wilmington, Delaware (deal in coal, limestone, etc.) Capital $5,000,000.

The New Haiss Truck Loader

Naylor Spiral Rivetless Pipe

Recognition of the need for a light, easy-to-handle, but strong pipe, which would permit the free and easy flow of materials, resulted in the development of the Naylor Lock-Seam—the basis of the present Naylor Spiral Lock-Seam pipe—a pipe that combines economy and light weight with unusual strength and wearing qualities.

The machines on which the pipe is formed were designed and patented by Carl G. Naylor, president of the Naylor Spiral Pipe Company. A strip of sheet steel is wound into spiral shape but instead of riveting, the edges are automatically flanged and formed into a 4-ply lock-seam laid up on the outside of the pipe. The pipe is formed in a continuous piece and then cut in the desired sections up to 40 feet in length. It is made from number 16 to number 10 gauge sheets and from 4 to 30 inches in diameter. Plain, galvanized, painted and asphalted Spiral Lock-Seam pipe may be had to meet varying requirements.

The utmost in pipe efficiency is obtained from pipe which is of absolute unchanging diameter. If it were possible to roll sheets into round tubes and seam them by welding, riveting, or lock-seaming, you would not have a round pipe length after it had been handled and shipped, because the slightest blow or concussion would dent it.

Naylor Pipe is not rolled, but is wound upon a lathe turned arbor under very high tension and the edges of the steel are interlocked at the same time into a 4-ply seam. It is the stiffness of this 4-ply seam which makes the pipe as round as the arbor around which it is wound.

The lock-seam embodies several engineering features of interest. Exceptional strength is provided by the lock-seam formed with four thicknesses of steel, making a locked joint that is dependable for tightness and for structural strength. This strength is sufficient to resist the inside pressures and to double the natural rigidity of the pipe.

Another important feature is the smooth inside with no rivets to wear, or to rust out, reducing friction and minimizing the required driving power for the conveyance of materials.

Lock-Seam pipe finds an ideal application in cement, stone, lime, gypsum, and sand and gravel plants for conveying water for the various washing processes and for conveying materials in solution, as well as for use on exhaust steam lines, water supply to boilers and other places where a low pressure pipe is applicable.

A Section of Pipe Showing Naylor Construction